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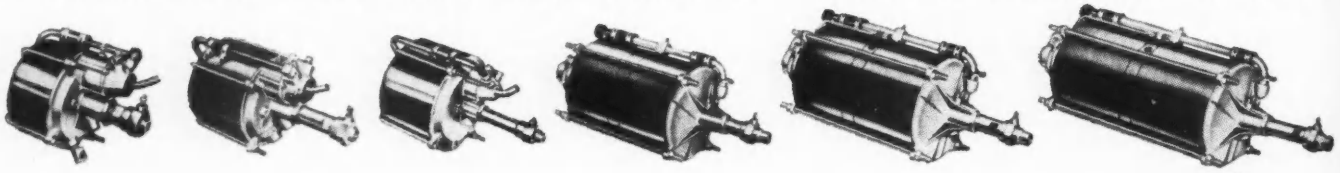

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AUTOMOTIVE and AVIATION INDUSTRIES

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October 15, 1946

What Comes Before the Guaranteed Annual Wage

By Julian Chase

BESIDES the assumed necessity and the cultivated desire of labor agitators to keep new issues constantly in the warming pan because their lucrative and sinecural jobs depend largely on such things, there is and always has been in the minds and hearts of all of us, employe and employer alike, a deeply felt longing not only for assurance but also for reasonably valid guarantees that from here on, or from there on, after some early future date, everything will be all right. We all have a natural yen for imaginary security.

Security is something that is hard to define. It is harder still to get. As a matter of plain, hard fact it is somewhat more than merely doubtful whether there is, ever was, or can be any such thing. The peoples of many European countries had what they thought was a form of security before the war. We have what is politically and misleadingly called social security in this country now. But how much actual security can there be in any part of this world in these days of uncertain peace and atomic bombs?

How much and what kind of security can there be here, even considering only domestic affairs, in these days of discounted thrift, discarded self-reliance, augmented disinclination to earn one's keep and provide for the future by the sweat of one's brow, and cowardly acceptance of corrosive communistic doctrine? The guaranteed annual wage, if it were a practical possibility, could not, under existing conditions, give us more security than we have now. It probably would give us less.

Before the guaranteed annual wage there must come a lot of other things. The outstanding prerequisite at the moment is greater worker stability in a more nearly stabilized economy. The next most conspicuous missing essential is maximum worker productivity. How can any employer guarantee an annual wage and steady employment with stiffled production, increasing costs, rising prices and shrinking markets for his products?

C. E. Wilson, President of General Motors, recently said, "The (guaranteed) annual wage is a feasible thing only in a stabilized economy, and if you have a stabilized economy, you don't need it. If the annual wage means paying people for not working, you have just created another difficulty in business." His use of the word difficulty would seem to make of the latter part of his utterance a notable example of understatement.

Before the guaranteed annual wage can even be considered there must come a workers' substantive guarantee of production, a guarantee backed by demonstrated conviction that the maximum of attainable security can be had by anyone only as a result of his own individual effort. And then, as Mr. Wilson said, it won't be needed.

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There are many requirements that we cannot handle today, but it is often surprising what can be done with the close cooperation of your nearby Ryerson plant. If needed steel is out of stock the Ryerson salesman will sometimes be able to suggest a practical alternate steel, or he may know a way in which flame cutting, forming or welding can serve to provide a workable substitute.

So we urge you to keep in touch with us. Our whole organization is doing everything within its power to help every customer get the steel he needs.

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SAE National Aeronautical Meeting

First Postwar Sessions on West Coast Devoted to Powerplant and Transport Developments

By R. Raymond Kay

IN LOS ANGELES early this month the first postwar SAE National Aeronautic Meeting on the West Coast was greeted with what Californians prefer to call "unusual weather"—lightning, "liquid sunshine," and thundershowers. However, enthusiasm was not dampened, for Dr. A. L. Klein, Douglas Aircraft, as general chairman, had arranged a full program on jet propulsion, passenger comfort, power control, air transport regulation and comparative studies of the techniques of flight employed by man, insects, and birds.

Twenty-three papers were presented at this October meeting and, as was to be expected, the subject of military aircraft, on which major emphasis was placed during the war years, was not prominent on the agenda. Attention was focused this year on powerplants and transport developments, and surprisingly enough to an audience composed primarily of West Coast airframe men, production of airframes was discussed in only one session. Attendance at the meeting reflected the decrease in the number of aeronautical engineers employed on the West Coast since V-J Day. Twenty-four national manufacturers, serving the aircraft industry, displayed their wares at the three-day session.

Abstracts of some of the most important papers will be published in a forthcoming issue of AUTOMOTIVE AND AVIATION INDUSTRIES. Here are highlights of several of the papers.

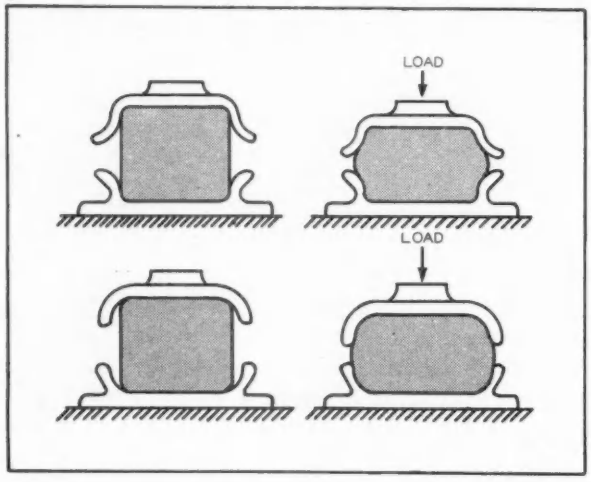
The introduction of the turbo-prop in commercial transport service will depend on its superiority over the conventional reciprocating engine. According to Franklin W. Kolk, American Airlines, in his paper, "The Future of the Gas Turbine in Air Transportation," airline operators have no basic concern whether the power plant they operate is a reciprocating engine or a turbo-prop if either power plant will perform satisfactorily. There are two circumstances which may lead to the widespread adoption of turbo-props in transport service. The first and most likely circumstance is the one in which the turbo-prop will, when installed in a suitable airplane, make possible an operation that would be impossible with the use of a more conventional power plant. This service might be made possible by one of several characteristics, such as availability of higher horsepower ratings, lower specific fuel consumption, or much less installed weight. It is easy to see that this type of circumstance can only arise when the service contemplated exceeds the present operational limitations of airplanes, as for instance, exceedingly long range, exceedingly high speed or exceedingly high altitude operation. The other circumstance under which the turbo-prop will supplant the conventional reciprocating engine will arise when the turbo-prop can be shown to be a better all-around power plant than a reciprocating engine for some presently established application. An example of this might be the replacement of the reciprocating engines in the DC-6 with turbo-props. This circumstance is regarded as much more unlikely because of the relatively undeveloped state of gas turbines compared to the very highly developed state of reciprocating engines.

Fundamental requirements and methods associated with providing uncompromised air freshness, temperature conditioning and humidity comfort for passengers and crew of a typical large pressurized transport airplane, such as the Douglas DC-6, for flight under 30,000 ft, were presented by Bruce E. Del Mar, Douglas Aircraft Co., Inc. First step in the designing process was to determine the conditions required for maximum passenger comfort. This was done by subjecting a full-scale section of the DC-6 cabin, filled

(*Turn to page* 62, *please*)

Rubber S

Fig. 1 — For heavy loads straight loading compression blocks can be used and the load-deflection characteristics controlled by the shape of the mountings.



AUTOMOTIVE suspensions are made up of three functional elements. First is the elastic element, with the accompanying shackles, brackets, bushings, etc., which furnishes the cushioning. Second is the shock absorber, with the bushings, yokes, pins, etc., for damping. Third is the structural design and attachments, which consist of the radius rods, stabilizers, linkages, supports, brackets, bushings, etc., which contribute to stability, steering, safety, vehicle control, elimination of rolling, elimination of bottoming and so on. In this article the discussion centers about the elastic element which shall be made of rubber in some form.

For the purpose of this article let us consider "spring rubber" the same as we think about "spring steel" and, also, let us proceed with the intent of using the elastic deformation and recovery properties of rubber properly designed and engineered to function as the elastic element in providing the proper functional characteristics such as load-deflection, periodicity, and rate. In some ways spring rubber is a more adaptable medium as a basis of design than spring steel. For example, spring steel is limited in its elastic deformation to about two per cent. Spring rubber, on the other hand, has an elastic deformation with recovery up to 600 or 800 per cent. It can be distorted enormously in many ways or directions with the result

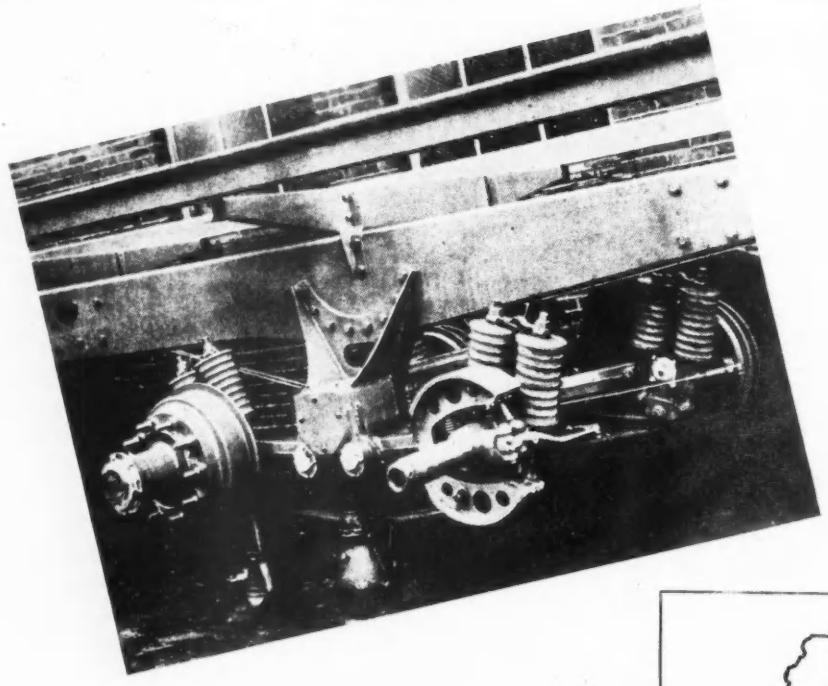


Fig. 2 (Above)—The Scammell truck suspension, developed in England, using stacks of rubber disks in compression for the elastic elements.

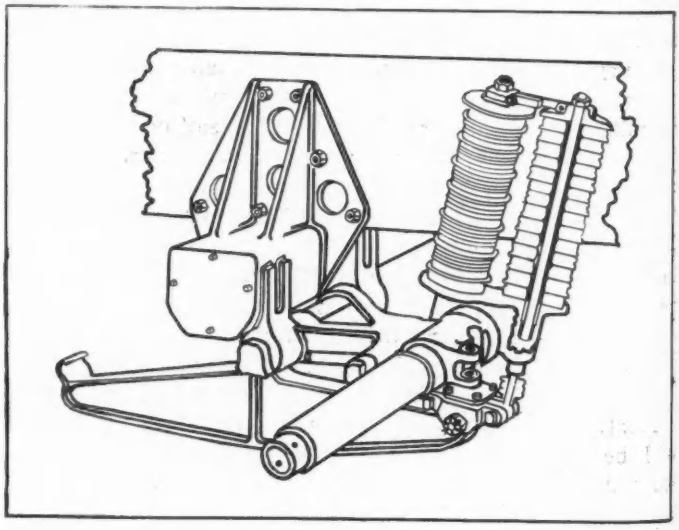


Fig. 3 (Right)—Sketch of a Scammell suspension showing the detail of construction.

Springs

Basic Properties of This Type of Elastic Element Are Discussed by the Author, Supplemented by Examples of Various European Automotive Applications

By J. E. Hale
Chief Engineer,
Firestone Tire and Rubber Co.

that the suspension designer can resort to a great assortment of linkages and load compoundings. He can devise an innumerable variety of ways of introducing elastic element into his mechanism and still be able to get the load-deflection, rate, periodicity, and damping characteristics which may suit the occasion. In addition, the rubber compounder can contribute to the functional effects desired by resorting to compounding characteristics which still further contribute to the final functioning of the elastic element.

In developing this article it has been convenient to use the term "elastic deformation" for rubber as a measurable quantity in tension, compression, or shear, as ordinarily measured in laboratory equipment, and also to use the word "distortion" not in a technical sense, but rather as a descriptive nontechnical reference to the way that rubber can be changed enormously in shape and configuration.

Using rubber as the elastic element of a suspension, we have a wide variety of basic functional forms. These can be classified: first, discriminating between straight loading and torsional loading; and second, discriminating between compression, shear, and tension as follows:

A. Straight Loading
   1. Compression distortion
      a. Block
      b. Column
      c. Special shapes
   2. Shear distortion
      a. Plate sandwich
      b. Coaxial bushing sandwich
   3. Tension distorsion

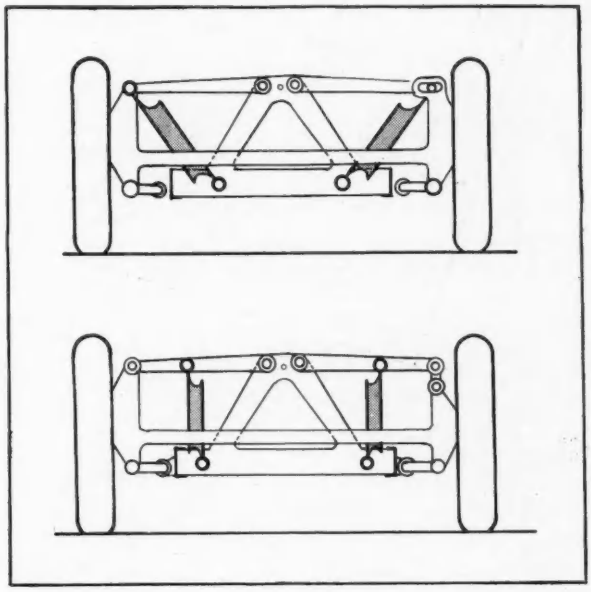


Fig. 5 (Above)—Sketches taken from a 1938 British patent of an Auto Union (German) suspension using bonded rubber sandwiches in shear.

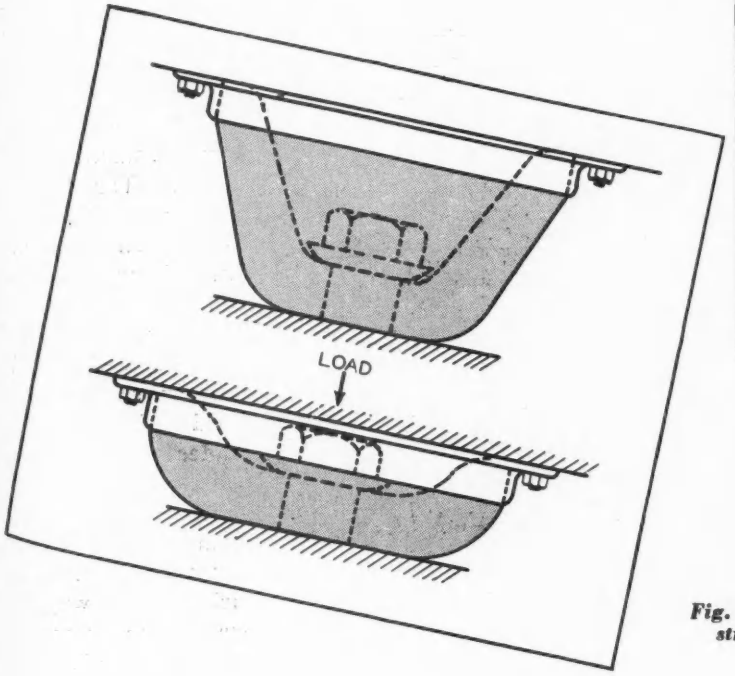


Fig. 4 (Left)—A thick walled bowl shaped straight loading compression member.

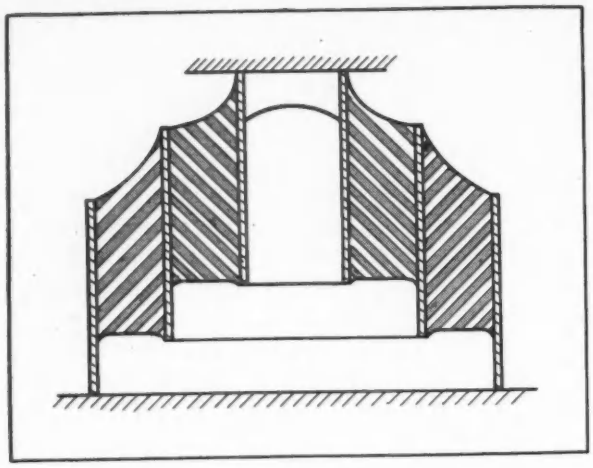


Fig. 6 (Above) — Concentric rubber bushings bonded to steel sleeves can be used as elastic elements for straight loading.

B. Torsional Loading
   1. Compression distortion
      a. Rotating cylindrical
      b. Rotating disk
   2. Shear distortion
      a. Rotating cylindrical: Torsilastic, Lord, Robertson
      b. Rotating—plate sandwich
      c. Rotating conical—Macbeth

To illustrate these various basic types, some sketches which are very elemental have been drawn just to convey the idea of the basic principle of each form of elastic element. In contemplating each of these basic forms, the suspension designer should be prepared to let his imagination or inventiveness envision the many variations of size and shape possible to fit into a successful suspension.

Fig. 1 shows a simple block in direct compression. The block can be deflected vertically 20 to 25 per cent. The sketch shows two different geometric mountings. These forms indicate the possibility of influencing the load deflection characteristics according to the way these mountings are designed. Since this is an example employing elasticity of rubber in direct compression, the relationship between the horizontal cross section area and the vertical height should be such that the block is broader than it is high in the interests of general stability. This form of elastic element is limited to very heavy loads where limited cushioning is desired. It is particularly adaptable for heavy duty applications.

Considerable work has been done on truck suspensions in rubber, judging from the details exhibited on some material attributed to the Scammell people in England as shown in Fig. 2. This illustration shows the two axles of a trailer fitted with compression disks of the column type. Fig. 3 shows the detail of this construction. In this form of direct compression spring a much greater deflection by compression can be utilized. For example, if one element is 1 in. thick, it can be deflected a maximum of ¼ in. The total amount of deflection desired can be accounted for by simply increasing the number of units in the assembly which incidentally can be provided with metallic guides for structural purposes.

Fig. 4 is another form of distortion in compression and is included by way of example to show the extent to which the

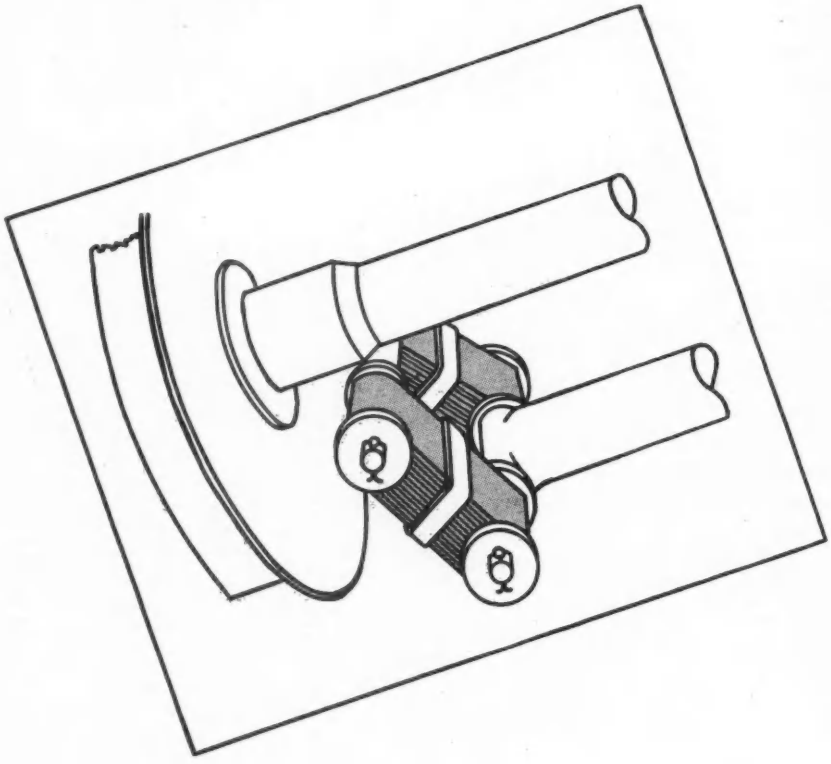


Fig. 7 (Above)— Layers of rubber bands stressed in tension.

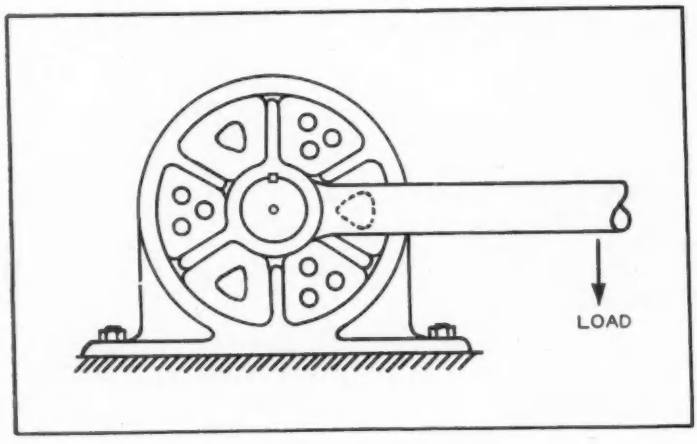


Fig. 8 (Right)—The rubber blocks in this cylindrical arrangement are compressed when the arm rotates upon being loaded.

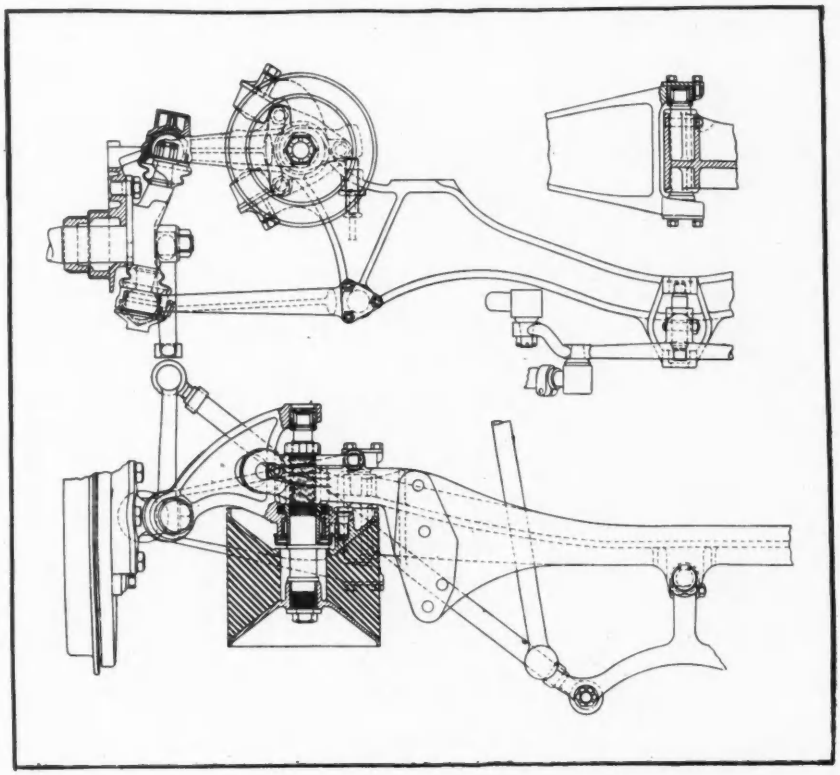
designer's ingenuity can turn in any one of a multitude of special shapes. In this particular case it is in the shape of a bowl with very thick walls. This design was actually made and tried on a trailer.

Now passing from compression to shear distortion; Fig. 5, an Auto Union (German) suspension patented in Britain in 1938, shows one of the innumerable possible forms of what might be called a plate sandwich in shear distortion. The elastic element in this case can be designed and cured effectively in large units. Fig. 6 is another form of sandwich which geometrically would be described as a coaxial bushing. Here again the designer can have a great range of dimensional and deflection possibilities according to the way he designs the elastic cushioning element. It would be desirable in the case of the coaxial bushing to make every reasonable attempt to recognize and provide for arranging of relationships of the bonded surfaces. This would require that the different diameter shells be graduated in length to equalize the bonded area and also that the wall thickness of the rubber be properly designed to give dimensional deflection characteristics commensurate with the uniformity of the shells, the first to the next, etc.

Fig. 7 shows in elemental form how rubber in direct tension might be used as the elastic element. In fact, most of us are familiar with shock cords used in light planes as the elastic elements. Obviously there are many possible varieties of the use of rubber in tension.

The first of a series in which the elastic element is loaded torsionally is shown in Fig. 8. In this case the torsion loading resorts to compression of the elastic elements which are provided with suitable cavities to permit distortion in compression. Also, in this particular form additional rubber under compression is provided to take care of rebound. In this particular form the diameter of the torsional unit would be relatively small with a rather lengthy axial dimension.

There are several forms in which torsion elastic elements can be set up in shear. The first of these is a cylinder form with the elastic element bonded to an inner and outer sleeve combination. This type was discussed in AUTOMOTIVE AND AVIATION INDUSTRIES,



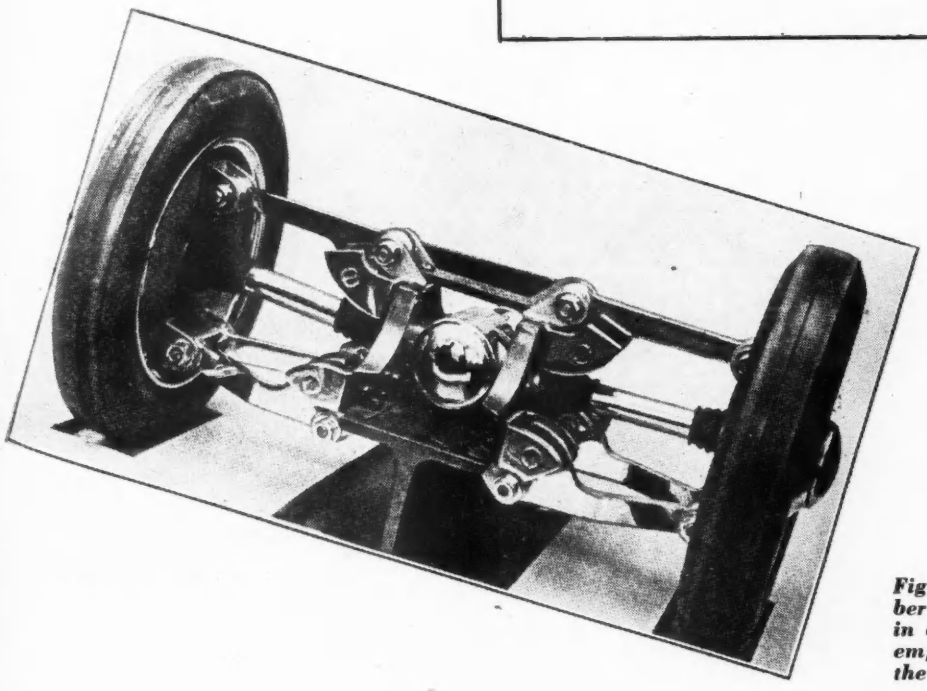


Fig. 10 (Above) Two views of the Macbeth front suspension which was installed on an English experimental car using rubber bonded to conical rotating parts.

Fig. 9 (Left)—A German rubber suspension which appeared in an automobile show in 1937 employs rubber in shear between the broadened ends of the links.

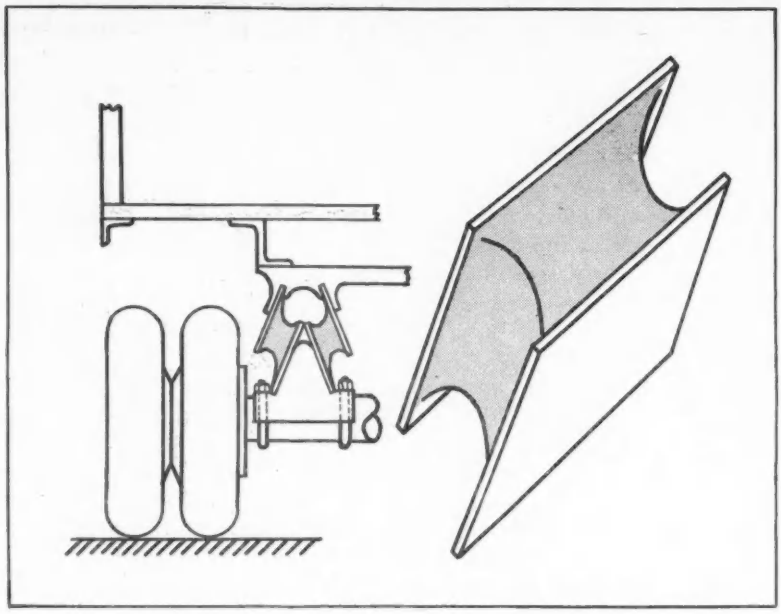


Fig. 11 (Above)—A bonded rubber plate sandwich scheme where the elastic element is loaded in compression and shear.

page 24 of the April 15, 1946, issue. The outer sleeve is split for manufacturing convenience and its holder is compressed to maintain pressure in its holder bracket and keyed against rotation. In order to get equal bonded areas the adhesion on the shaft is very much elongated. Shear distortion can be developed in a plate form as shown in Fig. 9, a German rubber suspension which appeared in an automobile show in 1937. In this case we still have torsional loading. The example shown is the rear of a car with provisions for independent suspension.

Fig. 10 shows what is probably a very promising type of rotating shear distortion which could be called a conical sandwich. This front suspension design was made for an experimental 18 hp Austin chassis, and is the contribution of Colin Macbeth of England who is a well-known rubber engineer. The idea is that the rubber would be bonded to the two conical surfaces and provisions be made for a mounting to develop torsional shear as the functioning action of the elastic element operating as a spring. The conical shape makes it possible to employ the rubber spring in torsion to the same degree of angularity from the inner diameter to the outer diameter thereby working the rubber uniformly all through the element.

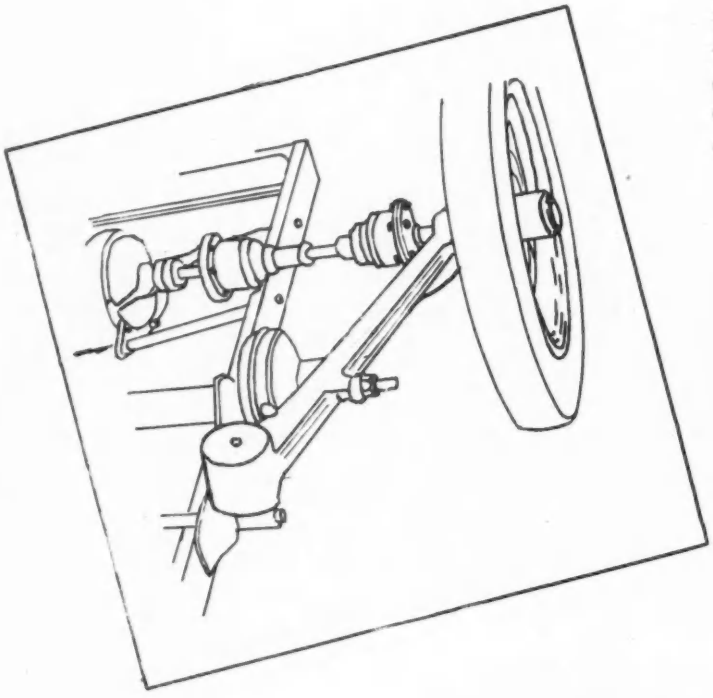


Fig. 12 (Above)—The Hirst suspension design using rubber in compression and torsion.

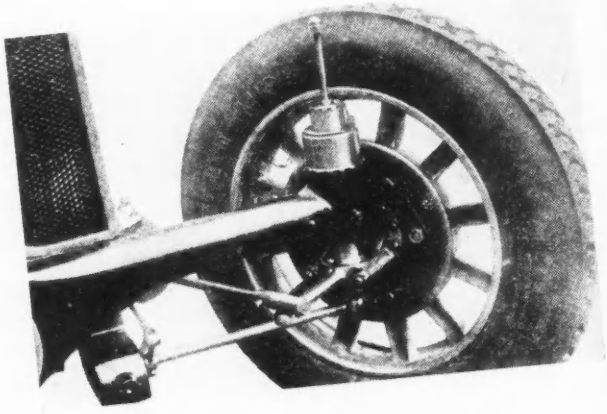


Fig. 14 (Above)—A left front wheel view of the De Lavaud suspension developed in France, see Fig. 15 for cross section sketch.

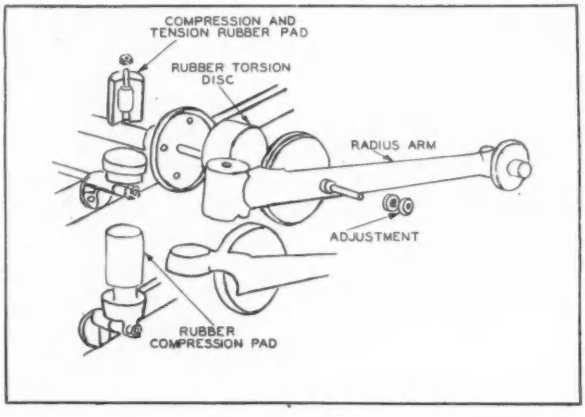


Fig. 13 (Right)—An exploded view showing the construction of the Hirst suspension.

Shown in Fig. 11 is a combination of shear and distortion. This form is a little bit difficult to draw in perspective because of the peculiar offset relationships of the two steel planes to which the rubber is bounded. This form is being worked on as a cushion element in the draft gears of railroad trucks. In the sketch a suggested treatment is shown as a spring for an automotive vehicle. Here again this element has great possibilities by virtue of the great variety of dimensional characteristics and elastic qualities of the rubber compounds that can be employed.

Another English rubber suspension is known as the Hirst design and uses rubber in both torsion and compression. This is shown in an assembly in Fig. 12 and in components in Fig. 13. The butt end of the arm is disposed about a fulcrum mounting on the side of the frame, and surrounding the fulcrum is a large disk of rubber compressed to give a frictional grip between metal disks with in-turned lips, one carried by the frame and the other by the radius arm. The assembly is held together by a lateral bolt with a nut adjustment for setting the grip of the metal disks upon the rubber disk. Elsewhere on the radius arm, in front of or behind the fulcrum, is placed a cylindrical rubber pad contained in telescopic metal sleeves. Movement of the road wheel upward compresses this rubber pad, and movement downward places it in tension by means of interior anchorages. The metal sleeves are so arranged that the compression of the rubber is unrestricted over a certain range, beyond which the volume of the sleeve is contracted sufficiently to be filled entirely with the rubber so that further compression is prevented.

Again we have the idea of the stack of compression disks in Fig. 14, the external view of the De Lavaud (French) assembly on a left front wheel. Fig. 15 is a line drawing showing how this is very neatly worked into the construction of the king pin as well as the spring. This suspension is somewhat limited in travel up and down since only those disks (not cross hatched) below the piston head are compressed when the wheel moves upward. The disks (cross hatched) that are

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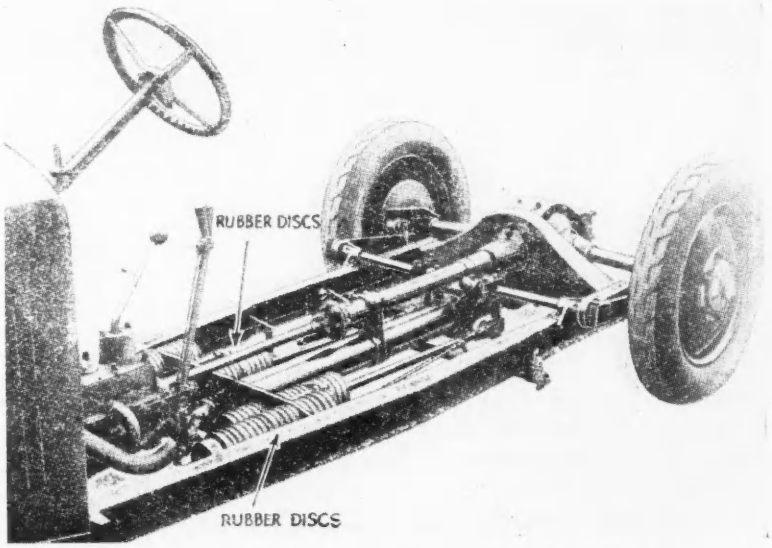

Fig. 16 (Above)—A French design by Garson employs multiple rubber compression disks arranged longitudinally between the side rails. All four wheels are independently suspended.

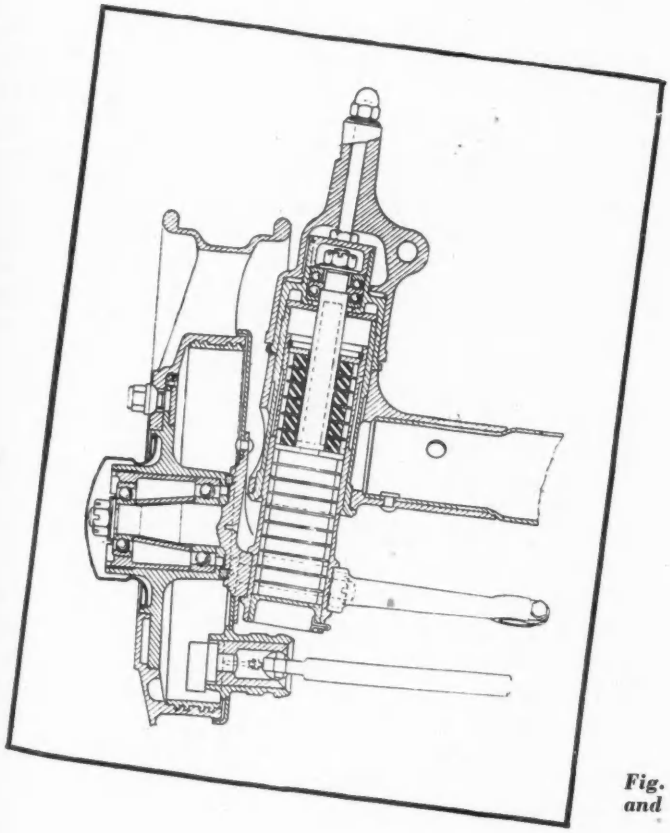

Fig. 15 (Left)—The function of the front spring and the king pin are worked into the De Lavaud suspension.

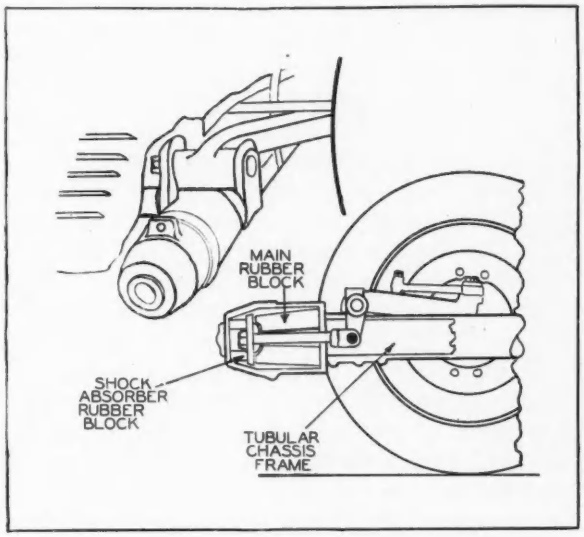

Fig. 17 (Above)—Rubber blocks in compression mounted directly on the ends of the tubular side rails of the frame are used in the Harris Leon Laisne, another French design.

Present Status of the Automobile I

By Raffaele Sansone

Genoa, Italy

THE Italian automobile industry, taken as a whole, did not suffer during the war to the extent as did many other industries. This has been due in part to the ever greater requirements of transportation of every nature after the continual increase in the damages suffered by the railways; in part through the opening up of new frontier routes with Germany and other nations; and in part through the necessity of deliveries of foodstuffs and war materials from one Italian region to another.

Although unceasing destruction caused some producers to suffer severely, others were able to continue their work on a fair scale, having however to satisfy more war requirements than civil. Their work was not only distributed over the reconditioning of vehicles, but also over the development of new models. After the arrangement of the Armistice a marked change was to follow. Prewar production was resumed, in many cases only to a limited extent, but also a surprising number of new automotive vehicles for civil service were launched on the market. Most of this constituted an important step forward in the economizing of fuel and materials.

Early in March there appeared the new D-65UCN (unified, civil, naphtha) truck of the Isotta Fraschini firm. It was the successor of the D-65UMB (unified, military, benzine, that had to be constructed during the war through the imposition of the military authorities. The New D-65 truck has a Diesel engine that does not represent a recent derivation of the benzine engine, but is to the contrary a reconstruction of the original engine with a Diesel cycle. Isotta Fraschini has not replaced in function, here, the 1942 engine, but has renewed it with improvements.

In the new crude oil (naphtha) engine the pistons that have the combustion chamber in their head, are smaller than formerly. The injector is of the central nozzle type. The Isotta Fraschini people mount different injection pumps, but those mostly adopted are of the Issa, Sisa or Spica type. In the transition from the naphtha to the benzene engine, and again to the naphtha engine the same disposition in the intake and exhaust ports has been maintained. In the new Diesel engine the intake valves are of larger diameter than formerly. The engine has four cylinders, with a bore of 4.258 in., stroke of 5.5, and total piston displacement of 354 cu. in. The naphtha fuel gives about 18 mpg without a trailer and about 11 mpg with a trailer.

The outstanding features of the Fiat "unified" 666N truck, shown in the illustration, are its high power-weight ratio, high speed, high towing capacity, ample cab space, extreme ease of handling, marked reduction of overall length and wheelbase. Other features are: ample load capacity, about 10 cu yd; easy withdrawal of the engine from the front of the chassis; clutch demountable without taking down the transmission; 5-speed transmission with three constant mesh silent gears and quick engagement; full floating rear axle; hydraulic brakes actuated by a compressed air servo mechanism and with emergency mechanical control; differential lock (optional) for running cross-country and on ground where traction is low; worm and roller steering gear; wheels with three-piece aluminum alloy rims for facilitating the mounting of tires.

The crude oil, four-stroke Diesel engine has six cylinders in line, bore 3.93 in., stroke 4.8 in., total piston displacement 350 cu in. At 2200 rpm and a compression ratio of 18:1, it develops 70 hp propelling a loaded truck at about 40 mph and giving about 10 mpg. The cylinder block has replaceable cast iron liners; the crankshaft has seven bearings and a vibration damper. A special centrifugal governor proportions the fuel admission to the power required. The radiator has seven detachable elements, air deflectors and a thermostat.

The power unit is resiliently mounted at three points. The two rear supports are fitted with rollers running on appropriate guides on the frame for facilitating withdrawal of the whole unit from the front. The transmission has five forward and one reverse speed. A 28 per cent grade can be climbed in low gear with a full load.

The overall length of the chassis frame is 18 ft 9.5 in.; wheelbase, nine ft 9.7 in.; front tread, five ft seven in.; rear tread, five ft 3.5 in. The turning radius is 18 ft. The net load is three tons; an additional gross weight of .5 tons can be hauled by connecting a box-body trailer that is 11 ft 8.5 in. long.

Two types of vehicles, which could be considered a composite of a tricycle and a small four-wheel vehicle were displayed in a recent mechanical and metallurgical exposition held in Turin. One of the types had a rear single-cylinder engine, the other a two-cylinder air-cooled engine of 15 cu in. total displacement mounted

Fiat 666N truck and trailer

Industry in Italy

in front. The transmission was on the rear wheels. The two constructions had a closed cab with two comfortable seats and a baggage compartment, very much like those of the Fiat Topolina car. The unique characteristic here was the narrow tread (19.7 in.) of the two small hidden rear wheels. The car seemed for this reason to run only on three wheels. This type construction eliminated the necessity of a differential without excessive wear on the tires or transmission, and without complicating the steering operations, even during narrow turns. On the other hand, there was avoided the overloading of a single tire as may occur in true tricycles, and in addition the danger of overturning the car. A disadvantage of this type construction was the limitation of the size of the wheels to permit a low position of the body.

The Fiat Motorcar Works exhibited amongst the other things the new heavy-duty truck. A-10,000 model, with four-wheel drive equipped with a rear double axle demanded by some truck operators. The Lancia motor car producers showed Lancia, Aprilia and Ardea motor cars and the truck model 3RO. The Moretti people displayed the small Cita car which seats seven people. They also showed a small electric motor car, and a series of electric accumulators for traction purposes. The Cita car had the appearance of a small, low version of the Topolino car. The rear wheels are of a narrower tread than the front wheels. The two-cylinder engine of 15.3 cu in. piston displacement, has lateral valves and transverse opposed aircooled cylinders.

In one of the stands of the CEAM was displayed well-known theftproof devices for motor cars, while in another was shown the new Stilma hydraulic jack which can be operated from within the car.

The new large Macchi truck, model R3, with trailer was presented by Ditta Mazzola. A new benzene-electric autocrane was shown by Ditta Emanuel. There was also shown a new very large Savigliano Diesel-powered tractor having a weight of nine tons and with eight speeds.

The new mobile auto-utilization-apparatus, Emanuel T5420, was exhibited. With this ingenious creation it is possible to execute all services required by motor cars, motor cycles, buses and airplanes, inside the shop or in the open. The auto-utilization apparatus provides for the rapid filling of pneumatic tires, automatically controlling their pressure; blowing and drying of machines after washing; pressure lubrication of bearings; the washing of auto engines with an atomized jet of petroleum; the emptying and filling of engine crank cases. It can be utilized for working a hydraulic jack. No special installation is required for placing it in service, as all that is needed is a normal tripolar electric current. The auto-utilization-apparatus is easily moved, as it is mounted on a frame with rubber-tired wheels. It is furnished with an air compressing group for producing 6.5 cu ft of compressed air per minute, with a demountable cooling arrangement, a finned cylinder of special cast iron, a connecting rod and crankshaft in forged steel, an exterior flywheel of large diameter, and air delivery manifold with a wide cooling surface, and an air filter with silencer on the intake. The auto-utilization-apparatus has a height of three ft nine in., length of four ft seven in.; width of 23.6 in. and weight of about 440 lb.

The production of automotive vehicles in Italy from Liberation Day, April 25, 1945 to Dec. 31, 1945, consisted of 1879 passenger cars, 8948 trucks and buses, 1413 motorcycles, 1163 engines and 426 truck tractors. This production represented only 44 per cent of what the manufacturers had hoped to produce.

The defunct Associazione Nazionale Fabbricanti Automobili (ANFIA) has reorganized to function under the new title Associazione Nazionale Fabbricanti Automobili Affini (ANFIAA). The most im-

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The Highway T

The Automobile, The Highway and The Future

By Alfred P. Sloan, Jr.,
Chairman, Board of Governors

IN this great country of ours we take perhaps too much for granted. We fail too often to appreciate the importance of intelligent planning, of constructive effort, of experience, skill and hard work, and many other things essential in the evolution of our American way of living. The problem of the "Highway" falls within the same pattern.

As a representative of the automotive industry, I do not know how many times I have made the observation down through the years, that next to food, shelter and clothing, the motor car in its various forms, has had the first lien on the purchasing power of the consumer. And although this preference may be said to have both its social as well as its economic components, our experience in the war has fully demonstrated, I believe—even if the fact needed demonstration—that the social side, however important and useful it may be, is really a by-product. The fact stands out crystal clear that the American economy as now constituted, cannot function without the motor car, the motor truck and their supporting services. Many communities, even those embracing large aggregations of people—particularly those of more recent development—have been built around the motor car as a means of transportation. It is indispensable. In over 54,000 smaller communities the motor vehicle is the sole means of contact.

All this is not new. Most of us realize it from our own experience and observation. But we do not always stop to appreciate, because it is less apparent, how dependent we are, in the effective capitalization of this instrumentality of social and economic progress, on the highway and its problems of safety, adequate capacity, flexibility and convenience. The problem of the highways is in many areas—more than we appreciate—most acute, even today. And as of tomorrow, if we succeed in adopting such national economic policies as will permit the maintenance of the higher national incomes we have hopes of obtaining, and which scientific progress offers us, the resulting increase in our standard of living must of necessity reflect itself in an increased automotive population as compared with prewar practice. More people will want motor cars. And more can afford them. And they will extend the use of those they have.

It is clear that in the interest of an expanding economy we cannot afford to be without highways where highways are needed. Conversely, we cannot afford the waste of constructing and maintaining highways where they are not needed—all factors considered. Again, we cannot afford the inefficiency and dangers of inadequate highways. To insure this end result, the highway user should accept an equitable proportion of the cost of construction and maintenance. We must, I submit, attack these vital problems on a high scientific level of fact and analysis. The problem demands intelligent planning and effective administration.

I have always referred to our hope of a sustained high national income as we move into the postwar era, hence a more extensive use of our highways. The automotive industry and its supporting activities have, I believe, distinguished themselves down through the years in the development and use of advanced technological processes. While it cannot be fairly said that the scientific developments of the war have brought possibilities of change in automotive practice of a dramatic character, yet progress has been accelerated. And, in general, along a wide front of engineering and construction. I am confident that this group of industries can be counted upon to maintain the continuous progress of the past, offering year by year more effective, more efficient vehicles at increasing dollar value. To the degree that we can thus encourage and expand a greater use of the motor car do we support an expanding economy and contribute to higher increased employment on a wide economic front, the impact of which is sure to manifest itself in a great variety of related industries.

It may be a long road from here to there. Today, as you all know, the automotive industry is beset by all manner of limitations. It is not what we would like to do; what we had planned to do, or expected to do. It is what we are permitted to do. Indifferent workers take the place of effective workers. Work stoppages take the place of continuous operation. Absenteeism takes the place of full service. We attempt to solve strictly economic problems on the national level on the basis of a political formula. And, naturally, it does not work. And then some wonder WHY we are in such a mess. And we certainly are in a mess! And one of our own design. It is important to recognize that. At the moment our opportunities for accomplishment were never greater, on the one hand, and the obstacles against sound progress never more discouraging, on the other. But we must have a certain amount of faith in the future. Bad as the situation is at the moment, it should not prevent us from doing what we can, whatever limitations may be imposed upon us. That is the only way out. We usually manage to solve, in some way

PRESENTED here are abstracts of papers read before the Highway Transportation Congress sponsored by the National Highway Users Conference and conducted on the theme "A Positive Program for Highway Transportation" in Washington on September 26 and 27.

Transportation Congress

or other, such problems as have confronted us in the past. Somehow, even at great cost, unreasonable delay, the weakening of our economic position, and the acceptance of much less than we might have, we will, I believe, overcome the difficulties that face us at the moment—at least in degree.

How We Pay for Our Highways

By Charles L. Dearing,
The Brookings Institution

BETWEEN 1920 and 1940 we spent more than 41 billion dollars for the development of our road and street system. Yet at the end of this era large segments were obsolete by any modern standards and many critical problems had hardly been recognized, much less attacked. Important segments of the primary systems in most states failed to incorporate the best engineering knowledge to permit the safe, free, and economical flow of traffic. The growing paralysis of traffic on city streets indicated clearly that drastic rebuilding could not long be postponed if slow strangulation of automotive transportation were to be avoided.

Today, therefore, we are faced with the formidable task of virtually rebuilding our road and street system in order to realize the full potential economy, convenience, and safety of automotive transportation. That task will require staggering amounts of money. The issue is whether or not the methods developed during the past 25 years will produce the required funds and achieve the necessary results—with equity. In my judgment these methods will fail unless two trends are checked or reversed. First, dissipation of user funds must be stopped, and second, federal aid must be restored to its original and valid role.

Over-extension of federal contributions to highways is a trend which if carried to excess might jeopardize the future solvency of American highway management. There is sound justification for defraying a small portion of the total highway bill with general funds of the federal treasury because there are national interests which are well served by the original concept of federal aid. It should be obvious that when federal contributions exceed the amount necessary to accomplish these national objectives it will eventually become necessary to make highway users directly responsible for the additional outlays.

During the 1920's federal expenditure never exceeded 6 per cent of the total outlay for roads and streets, but by 1940 the proportion had risen to 28 per cent with current pressures in the direction of still greater federal contributions. If over-extension of federal participation in highway financing occurs, the co-operative relation that has served remarkably well to delimit the federal from the state role will soon terminate in a confiict for primary jurisdiction. The federal government would be forced to develop user charges that would duplicate in every important respect the system of charging now used by the states to support their general road systems. The inauguration of such a policy could be justified only on the assumption that the national government should replace the states as the manager of the country's principal roads. There is no evidence that any such drastic alteration of responsibility for road provision would contribute to administrative efficiency or to equity in taxation.

Between 1920 and 1940, all states had adopted user charges which shifted the full cost of major roads from the general taxpayer to the motor vehicle user. In addition, all states levied graduated charges based on the added costs incurred in the provision of adequate facilities for large, heavy and slow-moving vehicles. This was in line with a sound policy of highway finance producing a reasonably fair distribution of total costs among those who demand and benefit most directly from road and street use.

Imposition of these special charges made motor vehicle users as a class financially responsible for the rural highways that had been provided to meet their demands. In 1940, for example, motor vehicle users contributed over one and a quarter billion dollars for state and local roads and streets, or about three-fourths of the entire amount spent for this purpose by state and local governments. Additional highway expenditures of more than a billion dollars were derived from three sources: State and local taxes other than user charges, amounting to 467 millions, and federal funds aggregating 656 million dollars. Since 1930 there has been a marked tendency to violate standards of equity in the expenditure of user funds. The responsibility of motor vehicle owners for the highway bill has been extended to the support of vast mileages of local roads whose existence, condition and use are a matter of indifference to most motorists. This dissipation of user funds constitutes more than the violation of an abstract principle of equity. It has created serious practical problems. For example, much of the present unbalance in the development of our highway system could have been avoided had user revenues been properly applied during the past 15 years.

The expenditure of user revenues where they are least needed must give way to a sensible programming of these expenditures in accordance with traffic requirements.

The Road Ahead

By Albert Bradley,
Exec. Vice Pres., General Motors

MOTOR VEHICLE owners not only have been contributing to the states their full share of the cost of highways but for years have been making very substantial overpayments. Federal excise taxes, super-imposed on the payments to the states, exact from motor vehicle owners a disproportionate share of the general tax burden.

Maintenance and reconstruction of the country's highway plant are urgently required at many points. Unless every state has a sound long-range program for highway improvement, development will be seriously retarded and millions of dollars of motor vehicle taxes will be dissipated. Immediate ef-

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Mobile Electronometer

ELECTRONIC stress analysis applied to the testing and design development of commercial trailers by The Trailmobile Co., Cincinnati, Ohio, marks the practical adaptation of advanced scientific methods in this field. In principle, electronic stress analysis was used extensively during the war in the testing of airframes, airframe members and other parts of aircraft. It is claimed, however, that when Trailmobile adopted its present procedures several years ago, it represented the first application of the technique in the commercial vehicle field.

The use of the familiar Baldwin-Southwark SR-4 strain gages is not a novelty. What distinguishes Trailmobile practice is the development of a mobile test trailer (Fig. 1), towed by the vehicle being tested, and carrying all of the necessary instrumentation. It is a laboratory on wheels. The entire rig was designed and built by the engineering department and embodies many interesting features. For example, the amplification of the feeble current flow in the strain gages is accomplished through the use of two Brush electronic amplifiers. What is even more important is the use of the Brush recording chart type oscillograph which provides a permanent chart record of the behavior of each of the 48 strain gages.

It is common knowledge that the design of frames and commercial bodies is generally based upon accumulated empirical data coupled with calculated stress analysis of the structural elements. Despite such careful analysis it is somewhat difficult to accurately determine the location and intensity of loading. In some types of structures it is even difficult to estimate the exact direction of stress lines. Usually, if the structure behaves well in road tests and does not develop weakness, it is assumed to be satisfactory. Actually that structure may be too heavy in some sections, too light in others. Moreover, there may be areas of stress concentration which ultimately induce fatigue failure.

Fig. 1. (Above) Here is the Trailmobile Mobile Electronometer laboratory connected to a trailer ready for road test.

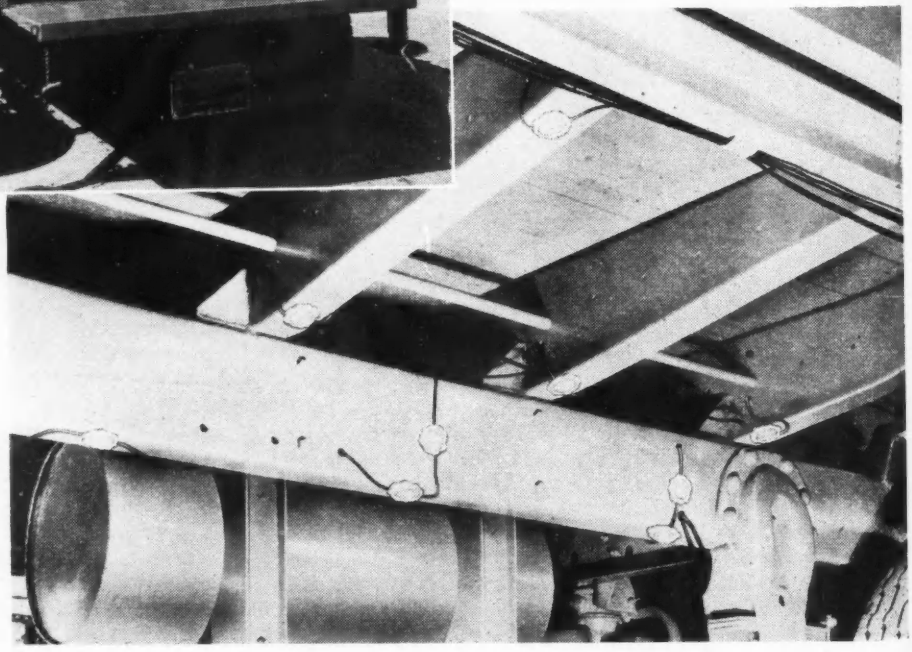


Fig. 2. (Right) Carried in wiring harness from the Electronometer are the individual wire connections to each of the 48 strain gages which have been securely attached to critical test spots throughout the test vehicle body and frame.

By Joseph Geschelin

Records Stresses

in Vehicle Road Test by Electric Strain Gage Method

From the standpoint of good design and production economy the best structure is one which is completely balanced as to strength and life, and of minimum weight. Stress analysis of the kind to be described here combined with proper interpretation of results provides an exact knowledge of the direction and intensity of loading, permits the development of structures of adequate strength but minimum weight and yet superior in strength to convenional design. Weight is no longer a criterion of strength.

With the use of the Mobile Electronometer laboratory, Trailmobile subjects a test model of a new design to a series of long and gruelling road tests, thus simulating the extreme conditions of dynamic loading to which the vehicle may be subjected in actual service. This work is done before the vehicle is released for production. In the process the experimental department obtains readings of actual stress intensity in critical locations in the frame, body structure, body skin, running gear parts, brackets, springs, etc. (see Fig. 2). In addition, the equipment lends itself to the checking of the rate of brake application and release.

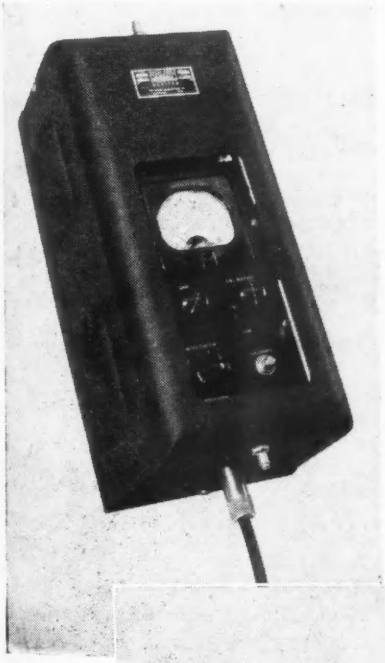


Fig. 3. (Left) Close-up of the Brush high gain amplifier, one of two units installed in the Electronometer.

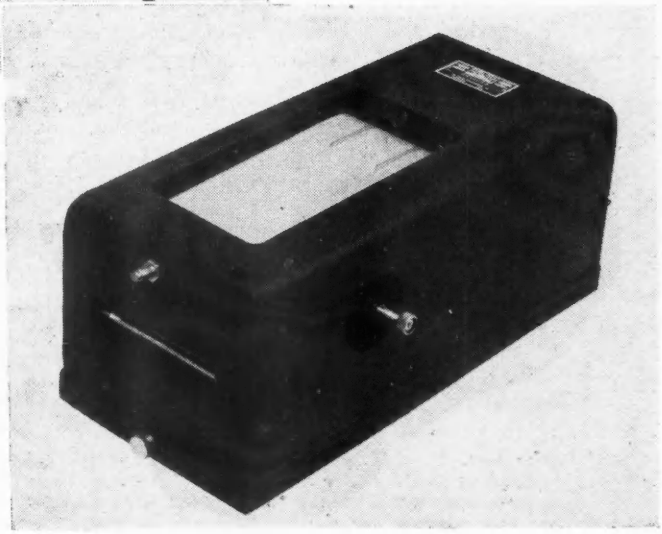


Fig. 4. (Below) Direct inking Brush oscillograph, shown here, is an important part of the test equipment.

Fig. 5. Close-up of the SR-4 Strain recorder switchboard developed by Baldwin-Southwark.

Test Equipment and Instrumentation

Primary function of the test equipment is to determine the actual stresses in any part of a structure under static or dynamic loading conditions, through the use of the SR-4 strain gage. This consists of a specially selected metallic grid comprising a fine wire 0.001 in. in diameter, cemented to a piece of paper. A small piece of felt covers the gage and protects it from injury and electrical short circuits. In use, the paper portion of the gage is firmly cemented to the

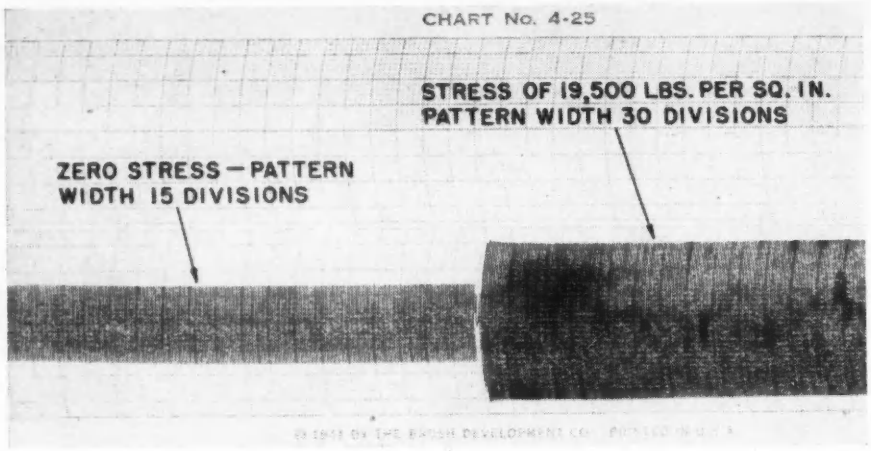


Fig. 6. Sample calibrating chart is made for each test, to show the width of the zero stress reading and of stress pattern for 19,500 psi loading. Test readings for the vehicle then are related to the standard pattern.

part to be tested.

Whenever a load is placed on the structure, definite stresses are created in the parts making up the assembly. The amount of stress depends upon the amount of load, the manner in which the load is applied, shape of the member and type of mounting. This stress is caused by the elongation or contraction of the metal in the supporting member, depending on whether the metal is in tension or compression. Since the test gage is cemented directly to the metal, the wire filament in the gage will stretch or contract the same amount. When the gage stretches, its electrical resistance becomes greater, and when the gage contracts, its resistance becomes smaller. Thus the change in resistance becomes an accurate indication of the stress produced in the metal to which the gage is attached.

Since the original gage resistance is 120 ohms for a type A-1 gage, and since the resistance of the gage will change approximately 0.15 ohms for a stress of 20,000 psi, it is obvious that this small change in resistance cannot be detected or measured by ordinary recording instruments. To overcome this difficulty, a Wheatstone bridge circuit is used, consisting of four 120 ohm resistors arranged as the four arms of a bridge circuit, the fourth arm being the strain gage under test. Six volts a-c current are applied across two arms of the bridge, and the output which is connected to the two remaining arms is fed into a high-gain brush amplifier (Fig. 3). The output from the amplifier drives the piezo-electric crystal motor of the direct inking brush oscillograph (Fig. 4). The width of the graph produced by the pen is an indication of the stretch or contraction in the metal, and therefore of the stress produced in the metal.

The present switchboard, Fig. 5, provides for 48 strain gages, tested one at a time, each one being connected to a separate Wheatstone bridge circuit. Three arms of each of the 48 bridges are SR-4 gages mounted on a specially selected steel test bending beam which provides means for the initial balancing of each bridge.

A group of automatic telephone type switches permits switching from bridge to bridge, the design being such that the bridge circuits are not broken by the switching action. In effect, an entire bridge is switched out and another switched in. Thus it is possible to test up to 48 points at one time without changing the test setup.

Since the voltage output from the switching unit is very low—0.001 to 0.008 volts—some form of amplification is necessary to drive the oscillograph pens. The Brush amplifier provides a means of closely controlling the amount of voltage supplied to the oscillograph. The specifications of this amplifier are as follows:

Frequency Range .....1 to 500 Cps.
(Uniform within plus or minus 2%)
Input Voltage Range.....001 to 25 Volts (Peak)
Maximum Output Voltage.....700 Volts (Peak)
Input Impedance .....10 Megohms
Output Impedance .....100,000 Ohms

The model OBC Brush Direct Inking Oscillograph is designed to make instantaneous and permanent chart records of low frequency alternations, surges,

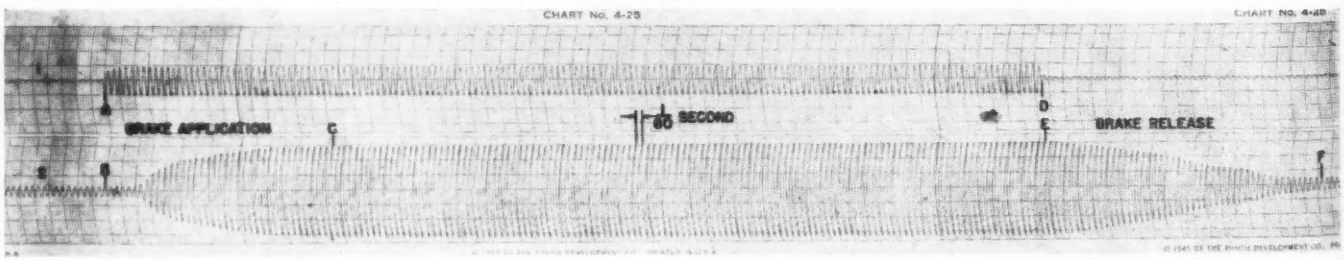


Fig. 7. Sample chart showing results of brake test. In this instance the equipment is calibrated for timing, each division being equivalent to 1/60 sec., as shown. The time interval for the brake application is obtained by counting the peaks from point B to C. Similarly, the time required for brake release is measured by the peaks from E to F.

Airbriefs

By Robert McLarren

Long Range Flight

Real secret of the record-breaking 11,237-mile non-stop flight of the Navy's Lockheed P2V twin-engine patrol plane, is now revealed as "pressure pattern" navigation, which enabled the craft, labeled the "Truculent Turtle," to cover this astonishing distance on only 8000 gallons of fuel. The new system, briefly, comprises the flying of a course laid along the outer edge of a series of low-pressure areas, into which high-pressure air flows, thereby insuring nearly constant tailwinds along the course.

Ram Jet Engine

The National Advisory Committee for Aeronautics has revealed a 400 lb ram jet engine of 2-in. diameter and capable of operation at speeds as great as 1500 mph, delivering thrust equivalent to 20,000 hp. A compression ratio of 8 to 1 is achieved through the proper air intake shape. Since from 75 per cent to 90 per cent of the total useful energy of a turbojet engine is utilized in driving the compressor, which produces a compression ratio of only 2½ to 1, the tremendously large power available together with high efficiency of this simple engine is apparent. A description of the ram jet engine appeared in the Sept. 15 issue of AUTOMOTIVE AND AVIATION INDUSTRIES. Its application to supersonic guided missiles is being pressed by the Army Air Forces, Naval Aviation, Army Ordnance Department and the Navy Bureau of Ordnance.

British Research

Great Britain is making an all-out bid to regain its postwar ranking with the United States and other nations in aeronautical research with construction already under way on an $80,000,000 research center near Bedford, England. First wind tunnel scheduled for completion is a 3 ft by 3 ft supersonic tunnel with an 8 ft by 8 ft type following soon afterward. Attempts to study supersonic phenomena via the piloted aircraft route have been shelved in favor of guided missile research work. The Miles M-52 supersonic aircraft project was cancelled with the airplane nearing completion. Rapid advances in the study of supersonic aerodynamics rendered the design obsolete before completion. Fully instrumented research missiles, with data relayed to the ground by telemetering equipment will be used by the British in their study of this complex problem.

650 Mph. Casualty

When the de Havilland Swallow, jet-propelled tailless airplane, suddenly disintegrated while undergoing final high speed flight tests in England preparatory to an attack on the world speed record of 616 mph, according to the de Havilland company it was flying at speed of 650 mph. At this speed, Mach Number 0.85, the flow over the wing was at a Mach Number of 1.1, considerably in excess of the speed of sound with accompanying shock wave formation and rapid, violent changes in the center-of-pressure of the wing. These latter are believed to have literally twisted the wings out of their root attachments, the resulting vibrations shaking the plane to pieces in a matter of seconds. Engineers point out that the Swallow was a composite design utilizing the fuselage of a standard de Havilland Vampire with special wing panels attached and a huge sweptback fin mounted on the jet engine exhaust duct.

Sonic Attempt

Meanwhile, plans were maturing for the first American assault on the sonic speed record by the Bell XS-1 in a series of flights to be made at Army Muroc Air Base. However, the XS-1 has been carefully designed for the purpose and the highest load factors ever used in the layout of an airplane were incorporated. Latest reports are that Chalmers "Slick" Goodlin, Bell test pilot, will make the historic flight.

It also has been revealed that Douglas Aircraft is grooming a second supersonic plane, the XS-3, which is claimed capable of a 1500 mph speed at an altitude of 200,000 ft. Rocket-propelled, as in the XS-1, the Douglas XS-3 will have power for four minutes, following which it will climb from 180,000 to 200,000 ft. on momentum. It differs from the XS-1 in that it incorporates a cockpit refrigeration system and a jettisonable cockpit. The cooling system is used to combat the extremely high temperatures generated by air friction at this great speed. The XS-3 is being built at the El Segundo (Calif.) Division of Douglas Aircraft Co.

Lightplane Research

More than 600 technical reports based upon wartime research by the National Advisory Committee for Aeronautics have been made available to the personal aircraft manufacturing industry. These reports were carefully selected from the thousands of wartime reports of the NACA as having special application to lightplane problems. More than 100 engineers and management executives of the lightplane industry attended an NACA-Industry Conference at the Langley Memorial Aeronautical Laboratory, Hampton, Virginia, last month to discuss lightplane research problems. Most pressing is the noise problem which is seriously hampering expansion of the nation's small airport building program. The NACA revealed research data through the use of which lightplane noise can be reduced to a point where a lightplane propeller is inaudible from a distance of 300 ft. Essence of the study is the use of multi-bladed fan-type propellers which turn at a much slower speed while delivering the same amount of thrust. Engine noise has been proved guilty of only about 2 per cent of the total noise of the airplane, the remaining 98 per cent being made up of the propeller tips, which travel at near-sonic speed on even small designs.

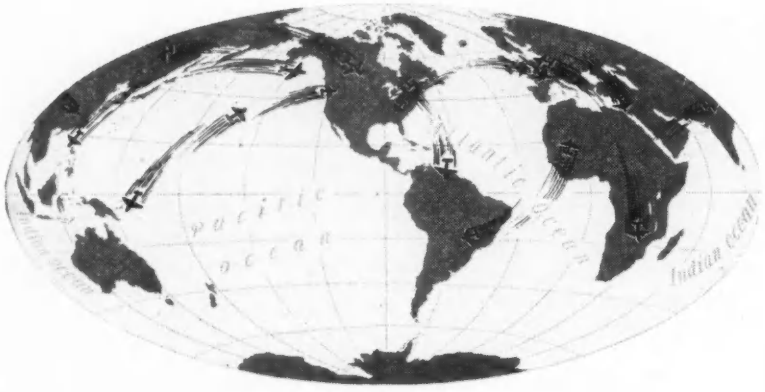
Waco Aristocraft

Waco Aircraft Co. of all the prewar lightplane manufacturers, continued its war work well into this year and has been among the last to announce its postwar model. However, the delay appears justified for in the Waco Aristocraft is contained some of the most radical design elements of any aircraft of its type announced (see page 43, Oct. 1 issue of AUTOMOTIVE AND AVIATION INDUSTRIES). Production models will sell for $9880.

Airline Volume

Any doubts that increased airline travel is just a mirage should be dispelled by the fact that for the first time in their history the airlines are now carrying more than one million passengers per month, a gain of more than 90 per cent over a year ago.

Proposed PICAO



Design Standards for Aircraft Structures (Continued)

Ground Loads

In the following requirements the landing gear is assumed to consist of two main-wheel units near the center of gravity, and one nose or tail-wheel unit. The prescribed velocities of descent and landing conditions which are prescribed herein shall be appropriately modified to provide for unusual characteristics of the airplane, or for special landing techniques.

It is recommended that the strength of the structure to which the landing gear is attached should be greater than the strength of the landing gear, in order that the later shall fail before the former.

DESIGN WEIGHTS—The maximum weights at which compliance with the ground-load conditions is required are as follows: (a) the design landing weight for the main landing conditions at the velocity of descent prescribed in Velocity of Descent at Design Landing Weight; (b) the design take-off weight for the main landing conditions at the Velocity of Descent prescribed in Velocity of Descent at Design Take-Off Weight; (c) the design take-off weight for the taxiing conditions.

MAIN LANDING CONDITIONS—The air plane shall be assumed to make contact with the ground under the conditions prescribed in Velocity of Descent to Landing Cases and Attitudes. The aerodynamic lift on the airplane during the landing impact may be assumed to be not greater than the weight of the airplane.

Velocity of Descent

At Design Landing Weight—The limit vertical velocity of descent, V, in terms of which the requirements are based, shall be:

V in fps $= 5.0 + 0.060\ V_{s_0}$; except that V shall be not less than 7.0 fps, and need not be more than 10.0 fps, where V_s is the stalling speed at the design landing weight, with wing flaps in the landing configuration, and is expressed in mph. If the fuselage has such a margin of strength above that of the tail-wheel unit that failure would probably be confined to the tail-wheel unit itself, the vertical velocity of descent for the design of the tail-wheel unit may be reduced to 0.8 times the above value.

AT DESIGN TAKE-OFF WEIGHT—When the design landing weight is less than the design take-off weight, the limit vertical velocity of descent associated with design take-off weight shall be at least 6.0 fps.

LIMIT ENERGY ABSORPTION—The airplane structure shall have sufficient strength to withstand loads resulting from a landing at the vertical velocity of descent, V, under the specified range of conditions, without bottoming of any of the energy-absorbing elements, unless such bottoming can occur without detriment to the continued safe functioning of that element.

RESERVE ENERGY ABSORPTION—The energy-absorbing properties of the landing gear shall be such that it will absorb, without structural collapse, the energy corresponding to a vertical velocity of descent not less than 1.18 V. Energy absorbed in distorting the structure may be included in complying with this requirement.

PROOF OF COMPLIANCE—The energy-absorption characteristics of the landing gear shall be determined by drop tests, up to the vertical velocity of descent V; provided that calculations may be accepted for simple landing-gear units, or for units similar to those for which test results are available. The characteristics of the landing gear at vertical velocities of descent in excess of V may be determined by any suitable means.

LANDING LOAD FACTORS—The airplane structure shall have sufficient strength to withstand the limit and ultimate load factors corresponding to landing at the limit vertical velocity of descent. The factor of safety of 1.5 is applicable in determining ultimate loads.

LANDING CASES AND ATTITUDES—The following landing attitudes shall be investigated, unless others are shown to be more appropriate:

(1) Level attitude.
   (a) Tail-wheel type—Level attitude; that is, thrust line approximately horizontal.
   (b) Nose-wheel type—(i) Main wheels and nose-wheels in simultaneous contact

Airworthiness Standards

for Commercial Aircraft in International Service

with the ground. (ii) Main wheels in contact with the ground, nose wheel just clear of the ground.

(2) Tail-down attitude.

(a) Tail-Wheel Type—(i) Main and tail wheels in contact with the ground. (ii) Main wheels in contact with the ground, tail wheel just clear of the ground.

(b) Nose-wheel type—Stalling attitude, or the attitude of maximum angle of attack permitting clearance of the ground by the tail structure, whichever is the smaller. Unless the configuration of the airplane is such that the likelihood of the tail stucture making contact with the ground is extremely remote, the structure shall have sufficient strength to withstand the loads imposed by such contact. In selecting the vertical velocity of descent for tail contact, the probable frequency of the occurrence shall be taken into account.

(3) Asymmetrical Landing — The airplane shall be considered to land so that the main landing wheel on only one side of the airplane is in contact with the ground. The ground loads on the wheel in contact with the ground shall be the same as those occurring on the one side in the level attitude, case (1). Unbalanced moments shall be placed in equilibrium with appropriate inertia moments.

(4) Lateral Drift Landing—The airplane shall be assumed to be subjected to a side-drift landing in which the side load at each wheel is equal to at least 0.3 times the maximum vertical load obtained in the level attitude, case (1). This side load shall be assumed to occur in combination with a vertical load between 0.5 and 1.0 times the maximum vertical load of case (1). In the case of castoring wheels, the side load may be reduced to that necessary to rotate the landing-gear unit about the castor axis, allowance being made for the effects of self-centering devices, anti-shimmy devices, bearing friction and incorrect adjustment. In estimating the side load occurring on a castoring unit, the wheel shall be assumed to be yawed to an angle of 6.0 deg at the instant of impact with the ground.

DRAG LOADS—The drag loads in cases (1), (2) and (3) shall be those necessary to accelerate the wheel in rotation, until there is no slipping between the tire and the ground when the airplane makes contact with the ground at 1.2 V_{s_0}. The coefficient of sliding friction between the tire and the ground shall have all values between zero and the maximum attainable. A maximum coefficient of sliding friction of 0.8 is considered acceptable. In establishing equilibrium of the airplane as a whole, average or suitable arbitrary values of drag load may be used.

Taxying Conditions

It shall be demonstrated that the strength and shock-absorbing characteristics of the airplane are satisfactory. To this end, operating trials of the airplane shall be made on ground simulating the roughest on which operation is intended. At least the following design cases shall be investigated, but consideration shall also be given to the necessity of amplifying or increasing the severity of these conditions to provide for unusual characteristics of the airplane or operating techniques. In the following cases, wing lift shall be assumed to be zero.

BRAKED RUN—The airplane shall be assumed to be in the level attitude. The vertical load factor shall be not less than 1.0. A drag reaction shall be applied at the ground-contact point of each wheel equipped with brakes. The drag reaction shall be 0.8 times the vertical reaction, but need not exceed the value corresponding to the maximum obtainable brake torque. It is recommended that the dynamic effects of pitching resulting from rapid application of the brakes be taken into consideration. Where the maximum obtainable brake torque is appreciably lower than that corresponding to a coefficient of friction of 0.8, it may be necessary to increase the factor of safety above 1.5 to provide a sufficiently rugged design.

TURNING AND SWINGING—The airplane shall have sufficient strength to withstand the loads occurring when the airplane taxies in a curved path when only the main wheels are in contact with the ground, the load factors at the center of gravity being not

Part III

This is the concluding part. Parts I and II appeared in the September 15 and October 1 issues respectively.

less than 1.0 vertically and 0.5 laterally. For airplanes likely to develop swing, (that is, having a tendency to ground-loop), the lateral load factor shall be suitably increased. A value of 0.6 is acceptable. In distributing the loads between the wheels on the two sides of the airplane, the rolling inertia forces shall be considered to be zero. The ratio of the side load to the vertical load at each wheel shall be equal to the ratio of the lateral load factor to the vertical load factor.

ADDITIONAL TAXYING CONDITIONS FOR NOSE AND TAIL WHEELS—Nose and tail-wheel units and their supporting structure shall have sufficient strength to withstand vertical and side loads appropriate to ground maneuvers normally encountered by airplanes of the particular type. Note: In demonstrating compliance with the requirements prescribed in this paragraph, the following design conditions are suggested as a minimum:

(a) Nose-Wheel Yawing Loads—A vertical load factor of 1.0 at the airplane center of gravity and a side component at the nose-wheel ground-contact point equal to 0.8 times the vertical ground reaction should be assumed. The vertical wheel reactions should be determined assuming static equilibrium.

(b) Tail-Wheel Yawing Loads

(i) Wheel Trailing—When a lock, steering device, or shimmy damper is fitted, a vertical ground reaction equal to the static load on the tail wheel, combined with a side load equal to 0.5 times the vertical load, should be assumed to act at the ground contact point of the wheel, except that, if means are provided to limit the torque about the castoring axis, this side load may be reduced to that permitted by such means.

(ii) Wheel Castored Through 90 Deg—A vertical ground reaction equal to the static load on the tail wheel, combined with a side load (perpendicular to the plane symmetry of the airplane) equal to 0.5 times the vertical load, should be assumed to act through the axle.

(c) Tail-Wheel Obstruction Load — A vertical ground reaction equal to 1.5 times the static load on the tail wheel, combined with a drag component equal to 0.66 times the vertical ground reaction, should be assumed to act through the axle, the wheel being in the trailing position.

Design and Construction of Control Systems

Controls shall be so located and arranged with respect to the appropriate flight crew members' seats that full and unrestricted movement of each control shall be possible without interference from flight crew compartment structures or from the clothing of the crew when seated. Compliance with this requirement shall be demonstrated for individuals of various sizes.

PRIMARY FLIGHT CONTROLS—Primary flight controls are defined as those used by the pilot for the immediate control of the pitching, rolling, and yawing of the airplane. When the primary flight controls consist of a control stick in front of each pilot or a column providing a grip or wheel in that position, and a pair of foot pedals for each pilot, these controls shall operate as follows: (a) a rearward displacement of the top of the stick, grip, or wheel shall cause the airplane to pitch nose up; (b) a displacement of the stick or grip towards the right, or a right-hand rotational displacement of the wheel, shall cause the airplane to bank right wing down; (c) a forward displacement of the right-hand rudder pedal shall cause the airplane to turn to the right.

TRIMMING CONTROLS—Trimming controls, and the means provided for indicating the position of trimming devices, shall be so arranged that they will not give a misleading impression to the pilot as to the airplane motion which will result from a particular movement of the control (for example, each trimming control may be arranged to operate in the plane, and with the sense of the motion of the airplane which its operation is intended to produce). Suitable precautions shall be taken to minimize the possibility of inadvertent or abrupt operation of trimming devices.

Means shall be provided, preferably adjacent to the control, to indicate the wing-flap position to the pilot. The wing-flap position indicator shall show the take-off, en route, approach, and landing positions. If any extension beyond the landing position is possible, the wing-flap-position indicator shall be clearly marked to identify such extension.

CONTROL-SYSTEM—All control systems and operating devices shall be so designed and installed as to prevent jamming, chafing, interference by passengers, cargo, or loose objects, and slapping of cables or tubes against parts of the airplane. Compliance with this requirement shall be demonstrated by suitable tests. All pulleys shall be provided with satisfactory guards.

STOPS—The range of motion of the control surfaces and of the pilot's controls shall be limited by stops. These stops shall be capable of withstanding the loads corresponding to the design conditions for the control system. Motions due to flexibility, beyond the limits established by the stops, shall be kept to a minimum.

CONTROL-SYSTEM-LOCKS—When a device is provided in the airplane for locking a control surface while the airplane is on the ground or water, compliance with the following requirements shall be shown; (a) the locking device shall be so installed as to provide unmistakable warning to the pilot while the lock is engaged; (b) means shall be provided to preclude the possibility of the lock becoming engaged during flight.

Design and Construction of Retractable Landing Gear

The following requirements apply to all retractable units of a landing gear, but need not apply in the case of tail-wheel units, if it is clear that incorrect functioning of such units would not be dangerous.

OPERATING CONDITIONS — The retracting

mechanism shall have sufficient power to retract and extend the landing gear at all speeds from stalling speed to a speed providing a safe margin above the stalling speed with wing flaps retracted, when the airplane is subjected to accelerations likely to be encounter. The following conditions are acceptable; (a) airspeed—from V_{s_0} to 1.6 V_{s_1}, where V_{s_1} is the stalling speed with wing flaps in the approach position at design landing weight; (b) accelerations—corresponding with airplane load factors from 0.8 to 1.3. If the movement of the landing gear is arrested during retraction and extension by transient accelerations outside the above limits, it should recommence as soon as the acceleration conditions are again within the limits and the operation should then be completed automatically without further attention.

STRENGTH CONDITIONS — When the landing gear is locked in the retracted position, it shall comply with the flight-strength requirements prescribed for the airplane as a whole. When the landing gear is locked in the extended position, it shall comply with the ground-load requirements prescribed for the airplane as a whole. The retracting mechanism and its supporting structure shall have sufficient strength to withstand the critical combination of loads resulting from the following; (a) all landing-gear positions; other than the retracted and locked; (b) all airspeeds within the limits selected in accordance with the foregoing specifications for operating conditions; (c) the airplane load factors prescribed for symmetrical conditions with wing flaps extended, (d) the loads imposed by the power source of the retracting mechanism; (e) the inertia loads resulting from the sudden stopping of wheel rotation by brakes.

LANDNG-GEAR DOORS — Landing-gear doors, their operating mechanism, and their supporting structure, shall be designed for the conditions of airspeed and load factor prescribed for the landing gear, and shall also have sufficient strength to withstand 25 fps gusts acting; (a) rearward, along the flight path; (b) laterally, perpendicularly to the plane of symmetry; while the airplane is flying at all speeds up to the landing-gear-operating speed or the landing-gear-extended speed, whichever is appropriate.

SECURING OF LANDING GEAR—Reliable means shall be provided to secure the landing gear in the extended position. Reliable means shall also be provided to secure the landing gear and its doors in the retracted position, unless it is established that inadvertent movement of the landing gear or doors from that position in flight, at any speed up to V_{DF}, demonstrated flight dive speed would not have serious consequences on the flight characteristics.

POSITION INDICATORS—Means shall be provided, easily visible to the pilot or to the appropriate members of the flight crew, to show whether each retractable unit of the landing gear is: (a) secured in the correct extended position; (b) in an intermediate position (unless the landing gear is visible to a number of the flight crew); (c) secured in correct retracted position.

WARNING DEVICES—Means shall be installed to give unmistakable warning to the pilot if he makes a landing approach with the landing gear not in the secured extended position. Such means shall be in addition to, and independent of, the indicator required by the preceding paragraph.

EMERGENCY OPERATION—When other than manual operation of the landing gear is employed, satisfactory emergency means of extension shall provide for the event of any reasonably probable failure in the normal retraction system. The emergency system shall provide for the failure of any single source of hydraulic, electric, or equivalent power supply in the normal retraction system.

BRAKES—Brakes shall be installed and shall be of sufficient energy-absorption capacity to provide adequate control during taxying, without the use of excessive foot or hand forces. It is recommended that the capacity of the brakes be adequate to prevent the airplane from rolling on a paved runway when take-off power is applied to any engine.

BRAKE ENERGY-ABSORPTION CAPACITY—If brakes are used to demonstrate compliance with the performance requirements, the capacity of the brakes shall be determined by suitable tests. The capacity shall be taken as the energy that the brake can absorb without failure or serious overheating, and shall be conservatively related to the energy actually absorbed in establishing the landing distance as prescribed for landing, in the section on Flight. Due allowance may be made for the energy absorbed by air drag.

(FROM FLIGHT: LANDING)—The horizontal distance between that point on the landing surface at which the airplane is brought to a complete stop, or, for seaplanes, to a speed of approximately three mph, and that point on the landing surface over which the airplane passed while at a height of 50 ft, shall be determined. In making this determination, the weight of the airplane shall be equal to the maximum landing weight at sea level.

Landing distance shall also be determined over such ranges of any of the following variables: airplane weight; altitude (in terms of standard atmosphere) and temperature; steady wind velocity parallel to the direction of landing; uniform landing-surface gradient; nature of landing surface.

In making this determination:

(a) immediately before reaching the 50-ft altitude, a steady approach shall have been maintained, with an airspeed of at least 1.3 V_{s_0};

(b) the nose of the airplane shall not be depressed, nor the forward thrust increased by application of engine power, after reaching the 50-ft altitude. At all times during, and immediately before, the landing, the wing flaps shall be in the landing position; except that after the airplane is on the landing surface, and the airspeed has been reduced to not more than 0.9 V_{s_0}, the wing-flap position may be changed;

(c) the landing shall be made in such manner that there is no excessive vertical acceleration, no tendency to bounce, nose over, ground loop, porpoise, or water-loop, and in such manner that its repetition shall require neither an exceptional degree of skill

(*Turn to page 70, please*)

Table I—Some Typical Heat-Resisting Alloys Tested in NRC-8 Program

Material	Alloy Number	Chemical Composition, Per Cent										Remarks	Maker*
		C	Mn	Si	Cr	Ni	Co	Mo	W	Cb	Ta	N_2		
Vitallium (cast)	NR-10	.242			26.7		Bal.	5.57						Austenal Laboratories, Inc.
422-19 (cast)	NR-12	.40		.51	24.75	15.92	Bal.	6.08					Fe 0.65	Haynes Stellite Co.
N-155	NR-21	.32	1.54	.59	21.08	20.80	20.54	3.00	2.18	0.98		.11		Haynes Stellite Co.
N-155 (d)	NR-21B	.36			20	20	20	3	2	1		.15		Haynes Stellite Co.
Nimonic 80	NR-29	.04	.56	.47	21.18	74.23							Al 0.63, Ti 2.44	Mond Nickel Ltd.
Gamma Columbium	NR-33	.40	.54	.62	15.22	24.60		4.14		2.20				Allegheny Ludlum & Universal Cyclops
S-495 (cast)	NR-34C	.46	.57	.71	13.90	20.68		4.14	4.17	3.93				Allegheny Ludlum Steel Co.
S-497	NR-45	.42	.47	.61	13.68	19.50	19.0	3.84	4.28	4.41				
X-41 (cast)	NR-47	.50	.50	.50	25.0	8.2	Bal.		7.5				CrB_2 1.75	
Timken 16-25-6 (b)	NR-49	.08	1.35	.69	16.72	25.23		6.25				.147		Timken Roller Bearing Co.
N-155 modified	NR-55	.39	1.75	.69	21.2	20.7		2.9	2.3	1.05	1.06	.12	No Co, plus Ta	Haynes Stellite Co.
TE	NR-57	.09	.70	.52	20	30		4	4.1		1.9	.15		Mass. Inst. of Tech.
TE-O	NR-58	.04	.70	.72	20	30		4	3.87		3.67			Mass. Inst. of Tech.
61 (cast)	NR-60	.42			24.07		Bal.		5.17					General Electric Co.
61 (cast) Lot No. 2	NR-60	.43	.28	.57	24.21		Bal.		5.38					General Electric Co.
Refractaloy	NR-62	.11	1.97	.25	20.3	20.1	30.2	8.3	3.8				Fe 15.3	Westinghouse Electric Corp.
6059 (cast)	NR-63	.46			26.17	½ bal.	½ bal.	6.4						Haynes Stellite Co.
N-155 (low C) (d)	NR-66	.06			20	20	20	3	2	1		.15		Haynes Stellite Co.
X-40 (cast)	NR-71	.48	.64	.72	25.12	9.69	55.23		7.23				Fe .55	Haynes Stellite Co.
X-50 (cast)	NR-72	.76	.58	.52	22.57	20.05	40.7		12.17					
S-590 Lot No. 1	NR-74	.49	.60	.21	19.50	19.78	19.35	3.95	4.15	4.04			Fe balance	Allegheny Ludlum Steel Corp.
S-816 Lot No. 1	NR-76	.38	.82	.25	18.87	19.70	45.64	4.04	4.71	3.43			Fe 2.94	Allegheny Ludlum Steel Corp.
N-155 boron-modified (low C)	NR-81	.12			21.5	19.5	19.5	3.1	2.0			.12	Boron 0.38	Union Carbide and Carbon Co.
Ticonium (cast)	NR-86	.18	.70	.37	27.46	31.42	32.46	5.29					Fe 1.56	Allegheny Ludlum Steel Corp.
Co-Cr-Ni base (9 Mo)	NR-87	.52	.70	.69	22.54	19.17	Bal.	9.09					Fe 0.9	Haynes Stellite Co.
Co-Cr base (9W)	NR-88	.44	.72	.68	22.47	3.18	Bal.		8.75				Fe 0.8	Haynes Stellite Co.
Co-Cr base (9 Mo)	NR-89	.42	.68	.68	22.73	2.88	Bal.	9.22					Fe 0.85	Haynes Stellite Co.
Co-Cr-Ni base (5 Mo, 5 W)	NR-90	.44	.76	.71	22.60	18.23	Bal.	5.18	5.09				Fe 0.8	Haynes Stellite Co.
Co-Cr base (9 Mo, low C)	NR-91	.08	.74	.60	22.66	3.18	Bal.	9.09					Fe 0.9	Haynes Stellite Co.
Refractaloy 26	NR-93	.03	.70	.65	17.9	37.0	20.0	3.03					Ti 2.99, Al 0.25	Westinghouse Electric Corp.
S-495 (low C)	NR-7	.16	.71	.97	14.50	20.54		3.87	3.84	3.79				Allegheny Ludlum Steel Corp.

*—The maker listed is not necessarily the only producer of a given alloy.

New Heat Resisting

By R. K. Winkleblack

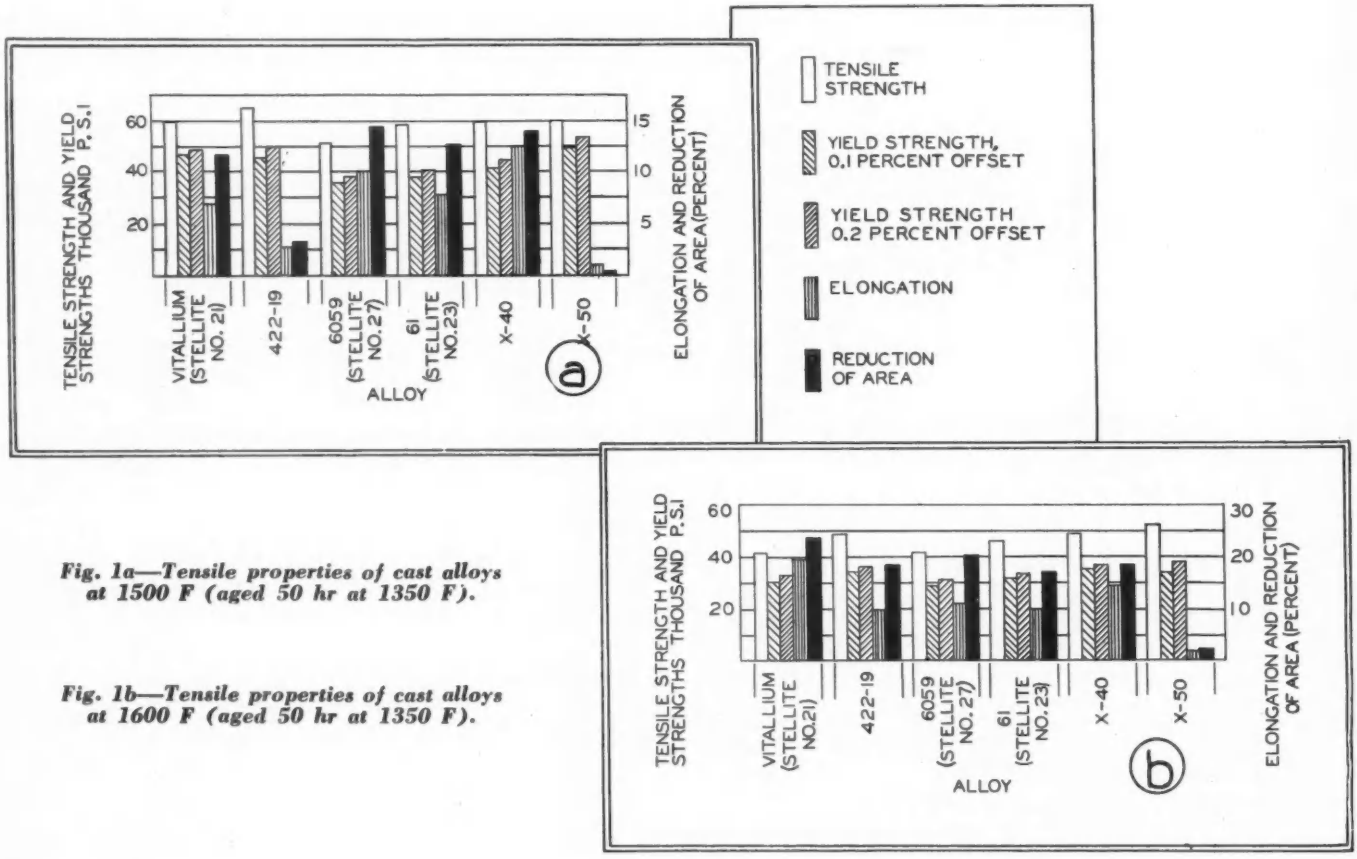


Fig. 1a—Tensile properties of cast alloys at 1500 F (aged 50 hr at 1350 F).

Fig. 1b—Tensile properties of cast alloys at 1600 F (aged 50 hr at 1350 F).

Metals *for* Engines

GREAT strides were made during World War II, and are continuing, in the development of metals that retain a high percentage of their strength under high temperature operating conditions. Due to wartime secrecy, most engineers have not had the opportunity to get a clear understanding of the capabilities of these alloys. Many of the restrictions have recently been lifted from this information. As the subject of heat-resisting metals is a very involved metallurgical study, a complete summary will not be presented in this article, which is intended to give only a broad picture of what design and development engineers can now expect of alloys for high temperature applications in internal combustion engines.

These alloys are principally of chromium-nickel-iron, cobalt-chromium, chromium-nickel-cobalt, and chromium-nickel-cobalt-iron bases. The War Metallurgy Division of the National Defense Research Committee in its final report on the subject, summarized the results from tests of 94 alloys. All of the materials were made and the test work was done by the laboratories and companies listed below.

American Brake Shoe Co., Battelle Memorial Institute, Crucible Steel Co., General Electric Co., International Nickel Co., Universal Cyclops Steel Corp., Lunkenheimer Co., The Midvale Co., National Bureau of Standards, Allegheny Ludlum Steel Corp., Crane Co., Federal Shipbuilding and Dry Dock Co., Haynes Stellite Co., Union Carbide and Carbon Co., Westinghouse Electric Corp., Massachusetts Institute of Technology, University of Michigan, Timken Roller Bearing Co.

Some of these high-temperature alloys can be rolled or forged, and are being made available in wrought form while others will be supplied in the form of precision castings. Table I lists some of the alloys tested in the NRC-8 program with their chemical compositions. At this stage of the development, the cast alloys of the Co-Cr and Co-Cr-Ni base type show better stress-rupture strengths at temperatures above 1400F than the wrought alloys. Figs. 1a and 1b give a graphic picture of tensile strength, yield strength, elongation, and reduction of area properties that a few of the cast metals possess at 1500F and 1600F. Table II gives an idea of the stresses these alloys will sus-

Table III—Data from Stress-Rupture Tests at 2000 F

Material	Alloy Number	Condition*	Stress—psi for Rupture in 0.5-1.0 Hr	2-3 Hr	10 Hr	100 Hr
Vitallium (cast)	NR-10	10A	8,000	.....	4,200	.....
422-19 (cast)	NR-12	10A	.....	8,000	5,500	3,000**
61 (cast)	NR-60	10A	8,000	.....	.....	.....
6059 (cast)	NR-63	10A	8,000	5,500	.....	.....
X-40 (cast)	NR-71	10A	10,000	8,000	6,300	4,000
Co-Cr base (9 W) (a)	NR-88	10A	10,000	.....	.....	.....
Co-Cr base (9 Mo) (a)	NR-89	10A	10,000	8,000	.....	.....
Co-Cr-Ni base (5 Mo 5 W) (a)	NR-90	10A	10,000	8,000	6,700	5,000

(a)—¼ inch-diameter specimen
**—Estimated
*10A—As cast and aged 50 hr at 1350 F

Table II—Data from Stress-Rupture Tests

Material	Alloy Number	Condition*	Stress—psi for Rupture in 10 Hr	100 Hr	500 Hr	1000 Hr
			At 1500 F			
Vitallium (cast)	NR-10	10	.....	21,000-24,000	14,500-17,000	13,500-15,000
422-19 (cast) (a)	NR-12	10A	.....	30,000	26,000	23,500
N-155	NR-21B	3	28,000	21,500	17,500	16,500
Nimonic 80	NR-29	3	29,000	17,200	.....	.....
Gamma Columbium	NR-33	2	22,500	16,700	12,500	11,000
S-495	NR-34	3	22,500	18,000	15,300	14,000
S-497	NR-45	3	.....	18,000	15,100	14,500
X-41 (cast) (a)	NR-47	10	.....	30,000**	26,000-27,000**	25,000
Timken 16-25-6	NR-49	1	19,000	12,900	9,800	.....
61 (cast)	NR-60	10	.....	25,000-28,000	20,000-25,000	20,000-23,500
Refractaloy	NR-62	2	24,500	19,000	16,000	15,000
6059 (cast) (a)	NR-63	10	33,500	24,000	19,500	17,700
N-155 (low C)	NR-66	3	23,500	18,800	15,000	.....
X-40 (cast) (a)	NR-71	10	35,000	27,500-28,500	22,500-26,500	21,000-26,000
X-50 (cast) (a)	NR-72	10	.....	29,500	24,000	22,000
S-590	NR-74	3 and 3A	27,500**	19,000-21,000	15,500-16,500	14,000-15,500
S-816 (cast) (a)	NR-76	3A	32,000	28,500-29,500	24,000	22,000-23,000
S-816 (forged)	NR-76	3 and 3A	34,000	24,000-25,000	19,000-20,000	17,000-18,000
N-155 boron-modified (low C)	NR-81	11 and 11A	28,000-30,000	22,000	18,000	16,000-17,000
Tyconium (cast)	NR-86	10	.....	20,000	17,500	15,000
Co-Cr-Ni base (9 Mo)	NR-87	10A	36,000	29,000	25,000	23,000
Co-Cr base (9 W)	NR-88	10A	41,000	32,000	26,000	24,000
Co-Cr base (9 Mo)	NR-89	10A	38,000	28,000	23,000	21,000
Co-Cr-Ni base (5 Mo, 5 W)	NR-90	10A	35,000	30,000	26,500	25,000
Refractaloy 26	NR-93	2B	40,000	28,500	21,000	18,000**
			At 1600 F			
Vitallium (cast) (a)	NR-10G	10	.....	17,500-19,000	14,500-16,000	13,500-14,500
422-19 (cast) (a)	NR-12	10	26,500	20,000	16,000	15,000
Gamma Columbium	NR-33	2	14,500**	10,800	8,700	8,000**
S-495	NR-34	3	.....	13,300	10,200	9,200
S-497	NR-45	3	15,000	11,500	9,400	8,600
X-41 (cast) (a)	NR-47	10	.....	19,500	18,000	17,500**
61 (cast) (a)	NR-60	10	.....	16,000	13,000	12,000
Refractaloy	NR-62	2	.....	12,000	10,000**	9,000**
6059 (cast) (a)	NR-63	10	.....	16,500	13,000	12,000
X-40 (cast) (a)	NR-71	10	.....	21,000	19,000	18,000
X-50 (cast) (a)	NR-72	10	.....	20,000	17,500	16,200
S-590	NR-74	3	18,000	12,500	10,000	9,000
S-816	NR-76	3	21,000**	14,000	11,000	9,500

(a)—¼ inch-diameter test specimen
*1—Air cooled and aged
*2—Oil quenched and aged
*2B—Aged 20 hr at 1500 F air cool, then 20 hr at 1350 F
*3—Water quenched and aged
*3A—Water quenched and aged 50 hr at 1350 F
*4—Cold-worked and aged
*10—As cast and aged
*11—Hot worked and aged
*11C—Aged 24 hr at 1900 F air cool
**—Estimated

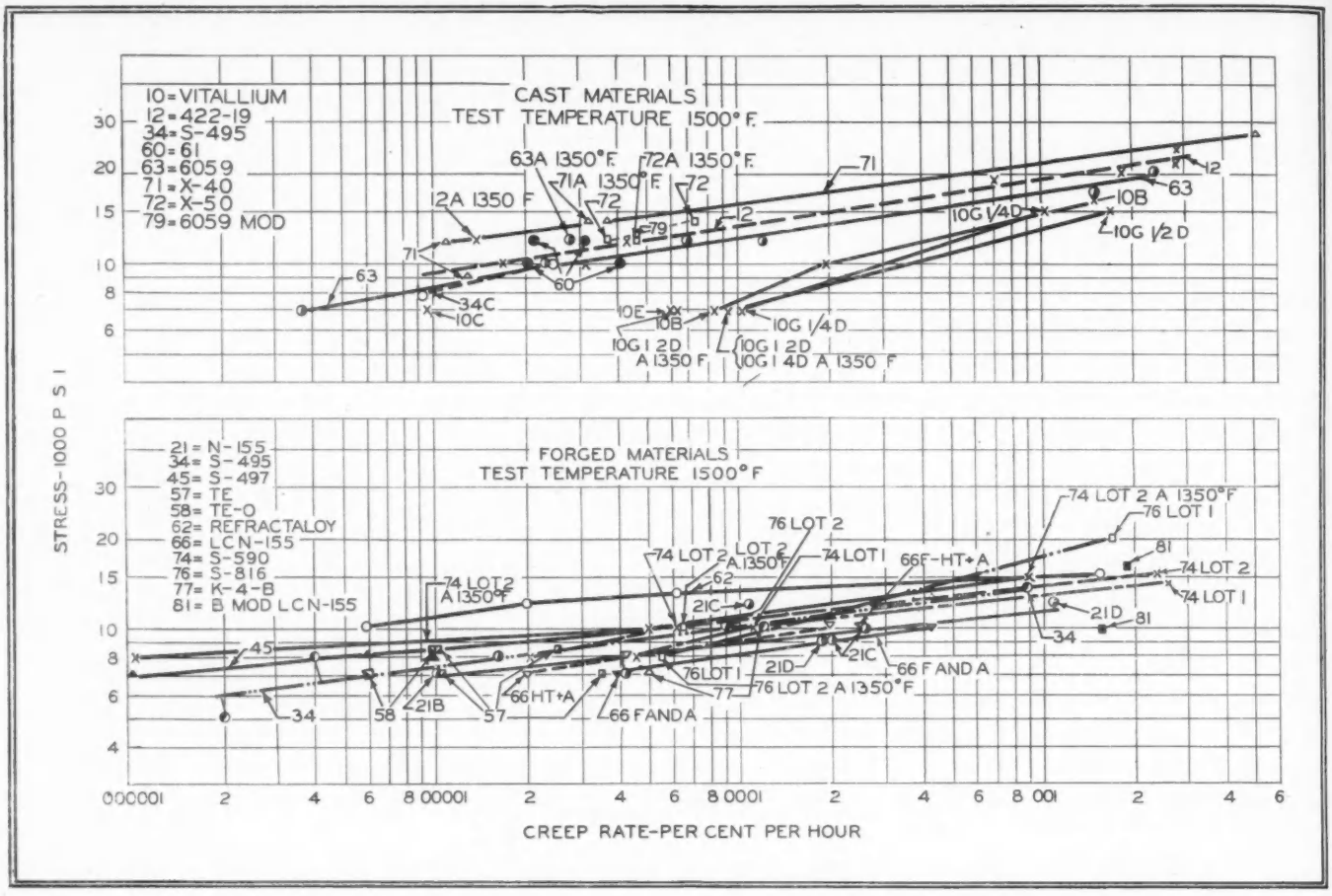


Fig. 2—Stress vs creep rate for cast and forged materials at 1500 F.

tain without fracture for a given time at the same test temperatures. Table III gives the stress-rupture test results for a few alloys at 2000 F. These tables and the creep chart, Fig. 2, show plainly that time is an important factor as well as load when metals are used at these severe temperature conditions. Creep rate must be kept in mind when fits and clearances are established on design drawings. Table IV lists creep data at a higher temperature, 1600 F.

Physical properties for a forged alloy used in gas turbine wheels are plotted against temperature in Fig. 3. This shows how most of the alloys decrease in strength at an ever increasing rate as the temperature is increased. Considerable work has been done to find the endurance and welding properties of these heat-resisting metals. Some of the results are reported in Tables V and VI.

The Crucible Steel Co. has an alloy CSA which is of the Cr-Ni-Fe type, the composition being C 0.35, Mn 4.0, Si 0.50, Cr 18.5, Ni 4.5, Mo 1.35, W 1.35, Cb 0.60, and the balance Fe.

Coefficients of thermal expansion, conductivity, hardness, and many other characteristics that are of importance to the design engineer vary widely among the alloys, and are often affected by various variables to which a given metal is subjected. Those who are

Table IV—Creep-Test Data at 1600 F for Heat-Resisting Alloys

Material	Alloy and Specimen Number	Condition*	Temperature of Test, F	Stress, psi	Duration, Hr	Deformation upon Application of Load, %	Creep Rate, Per Cent Per Hr at 500 Hr	1000 Hr	1500 Hr	2000 Hr	Total Deformation, Per Cent at 500 Hr	1000 Hr	1500 Hr	2000 Hr
Vitallium (cast).....	NR-10G-24 (a)	10	1600	5,500	2278	0.031	0.000002	.....	.....	.....	0.140	0.135	0.125	0.137
61 (cast).....	NR-60-74	10	1600	9,000	2448	0.045	0.00022	0.00015	0.00010	0.00011 (b)	0.306	0.398	0.415	0.500 (b)
X-40 (cast) Lot No. 1..	NR-71-7	10	1600	11,000	2016	0.085	0.000120	0.000030	0.000025	0.000025	0.182	0.208	0.220	0.240
S-590 Lot No. 2.....	NR-74-60	3	1600	7,000	2166	0.033	0.000063	0.000047	0.000061	0.000061	0.104	0.130	0.171	0.201
S-816 Lot No. 1.....	NR-76-16	3	1600	5,500	2181	0.020	0.000251	0.000311	0.000394	0.000333	0.211	0.354	0.572	0.895

(a)—¼ inch-diameter test specimen, 1.0-1.3 in. gage length
(b)—When discontinued at 2448 hr, rate 0.00012 per cent per hr, deformation 0.553 per cent
*3—Water quenched and aged
*10—Cast and aged

interested in a specific alloy for a special application will find the Office of Scientific Research and Development in Washington a source of detailed information.

Table VII shows some of the properties of metals used in production models of British gas turbines. The Jessop alloy known as G. 18B was specially developed for turbine disks, and the Mond Nickel alloy Nimonic 80 was developed for the blades. Composition of the latter is given in Table I. Stress-rupture data for this alloy, as determined in the NRC-8 program, is given in Table II as alloy number NR-29.

The cobalt-base alloys work harden extremely rapidly, which renders them difficult to fabricate. Nevertheless, simple forming operations on the cobalt alloys can be carried out and when conditions are particularly severe, either from oxidation, corrosion, or stress at the very high temperatures, the cobalt-base metals may be specified in sheet form. Ac-

Table V—Endurance Properties of Heat-Resisting Alloys at 1500 F

(Tested by Westinghouse Electric Corp.)
(Reversed Bending)

Material	Heat Treatment	Aging	Endurance Strength, psi	
			10^8 cycles	2.5×10^8 cycles
Vitallium Hirsch (cast)	None	None	41,000	.....
Stellite No. 23 (cast 61)	None	None	38,000	38,000
Hastelloy B	2050 F—air cooled	24 hr—1900 F—air cooled	34,000	.....
S-816 (cast)	None	None	33,000	.....
Stellite No. 21 (cast Vitallium)	None	None	33,000	.....
Low-carbon N-155	None	50 hr—1500 F	33,000	32,000
Stellite No. 27 (cast 6059)	None	None	31,000	30,000
6059 Austenal (cast)	None	None	31,000	.....
High-carbon N-155	2200 F—1 hr—water quenched	50 hr—1500 F	29,000	28,000
K-42-B	1950 F—4 hr—water quenched	20 hr—1300 F	28,000	.....
Nimonic 80	1950 F—4 hr—water quenched	50 hr—1500 F	27,000	25,000
Refractaloy 60	Not available	None	27,000	.....
S-495 (cast)	2350 F—1 hr—water quenched	20 hr—1500 F	22,000	22,000
N-153	2200 F—30 min—oil quenched	50 hr—1500 F	22,000	20,000
Camma columbium	2250 F—¾ hr—oil quenched	50 hr—1500 F	20,000	20,000
Timken 16-25-6	2150 F—¾ hr—water quenched	50 hr—1500 F	19,000	18,000
19-9 DL disk	2100 F—1 hr—air cooled	4 hr—1200 F	17,000	.....

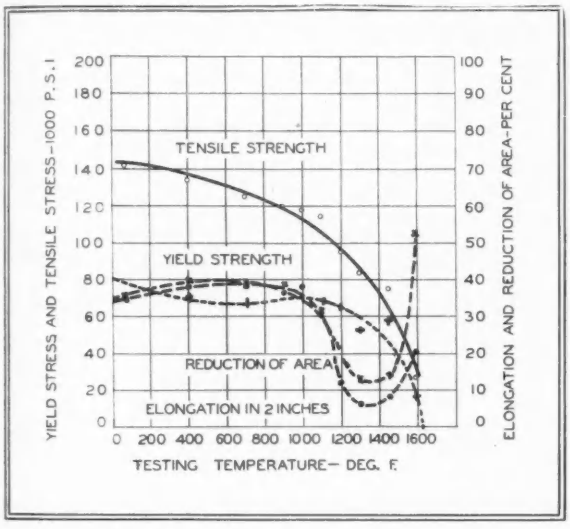

YIELD STRESS AND TENSILE STRESS—1000 P. S. I.
ELONGATION AND REDUCTION OF AREA—PER CENT
TENSILE STRENGTH
YIELD STRENGTH
REDUCTION OF AREA
ELONGATION IN 2 INCHES
TESTING TEMPERATURE— DEG. F.
0 200 400 600 800 1000 1200 1400 1600
0 20 40 60 80 100 120 140 160 180 200
0 10 20 30 40 50 60 70 80 90 100

Fig. 3—Physical properties vs testing temperature for modified Inconel (International Nickel Co.)

Chemical Analysis (%)—0.10 C, 0.60 Mu, 6.5 Fe, 0.01 P, 0.10 S, 0.55 Si, 0.12 Cu, 74.0 Ni, 15.0 Cr, 0.65 Al, 2.50 Ti.

cording to F. S. Badger, vice-president in charge of research at Haynes Stellite Co., the alloys given in Figs. 4 and 5 are available in the wrought form as sheet. These charts show the short-time strength and ductility of these alloys which are labeled with the Haynes alloy designation numbers. H.S. Nos. 21, 23, 27, 30, and 31 correspond to Vitallium, 61, 6059, 422-19, and X-40 respectively. The so-called stabilized stainless steels, types 321 and 347, have been used most extensively up to the present time where sheet had to be used at high operating temperatures. However, these alloys have not always shown as good life in service as is desired. For

Table VI—Results of Flash-Welding Tests on Heat-Resisting Alloys

Joint	Condition of Material	Visible Weld-Line Inclusions	Visible Diffusion of Metal Across Interface	General Description of Weld Region
Vitallium to Vitallium	Cast Cast	None	Complete	Fine-grained band
Vitallium to Timken 16-25-6	Cast Forged	None	None	Interface marked by distinct line
Vitallium to 19-9 DL	Cast Forged	None	None	Interface marked by distinct line
Vitallium to Low-carbon N-155	Cast Forged	None	Slight	Interface marked by distinct line
422-19 to 422-19	Cast Cast	None	Complete	Fine-grained band
422-19 to 19-9 DL	Cast Forged	None	None	Interface marked by distinct line
422-19 to Timken 16-25-6	Cast Forged	None	Slight	Interface marked by distinct line
422-19 to Low-carbon N-155	Cast Forged	None	None	Interface marked by distinct line
19-9 DL to X-40	Forged Cast	None	None	Interface marked by distinct line
19-9 DL to S-816	Forged Forged	None	None	Interface marked by distinct line
Timken 16-25-6 to X-40	Forged Cast	None	None	Interface marked by distinct line
Timken 16-25-6 to S-816	Forged Forged	None	Some indication of diffusion into S-816	Interface marked by double line
Low-carbon N-155 to X-40	Forged Cast	Few	Some	Interface marked by distinct line
Low-carbon N-155 to S-816	Forged Forged	None	Complete at center	No line at center Elsewhere, distinct line
X-40 to X-40	Cast Cast	None	Complete	Fine-grained band
S-816 to S-816	Forged Forged	Few	Complete	Fine-grained band

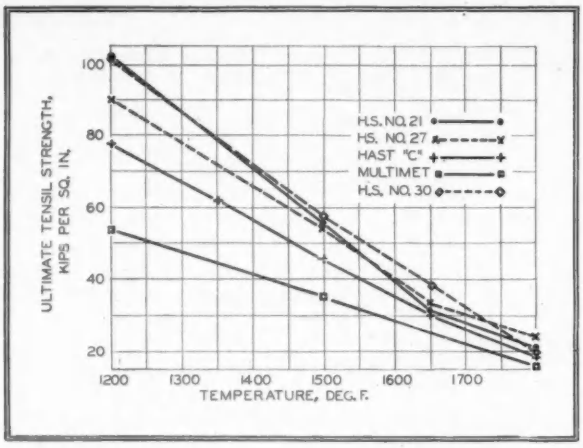


Fig. 4—Elevated temperature properties, short time tensile tests of sheet alloys.

this reason, the newer alloys are being given service trials even though their fabrication is difficult.

Two late developments that seem to show much promise are considerably different from the metals mentioned thus far. One is by the Climax Molybdenum Co. and is tentatively called Climax Moly NDRC Research. The chromium content of this alloy is unusually high even for the heat-resisting metals, being 60 per cent or over of Cr, plus 15 to 25 per cent Mo, and the balance Fe. It has very high rupture strength and other desirable qualities. The other alloy is being developed by the Vanadium Corp. and is known as Vanadium Corp. NDRC Research. The feature that makes this unusual is its high percentage of tungsten, chemical composition of the alloy being 25 to 35 per cent Cr, 20 to 30 Ni, 20 to 30 Co, 15 to 25 W, and 0.25 to 1.0 boron. Further details concerning these two alloys are not available for publication at this time.

The graphs and tables of this article were compiled originally for National Defense Research Committee reports, with the exception of Table VII, Fig. 4, and Fig. 5.

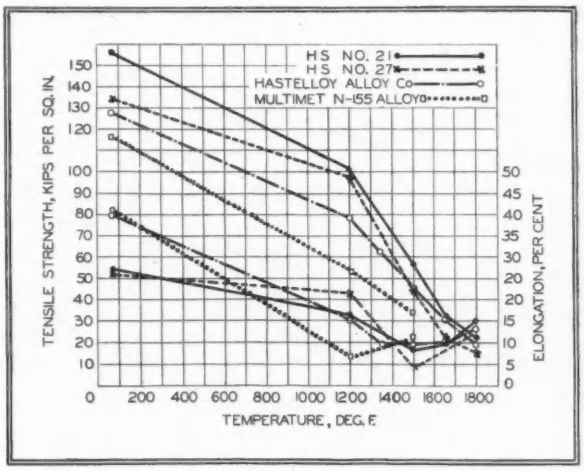


Fig. 5—Elevated temperature properties, sheet material under 0.040 in. thick.

Table VII—Heat-Resisting Metals Used in Great Britain

Material	Ultimate Strength (psi) 1292 F	Ultimate Strength (psi) 1472 F	Creep Strength (psi) for Fracture in 300 hr at 1292 F	Elongation at Fracture, per cent
Rex 78	58,300	42,900	22,000	7
Jessops G. 18B	61,600	49,500	28,600	10
Mond Nickel Minomic 80	92,400	74,800	34,100	2.5
Stayblade	30,800	.....	.....	..

Rubber Springs

(*Continued from page* 23)

above the piston head absorb the rebound shocks. The beam, to which these combination spring and king pin assemblies are attached, is pivoted at the center of the chassis with a friction device which permits movement when heavy impulses are imposed by going over a bump in the road.

Fig. 16, the Garson (French) design, shows the chassis with the independent suspension in the rear and the cantilever support for the wheels through the medium of the rubber disks in compression. It is to be noted that there are four stacks of disks and while the illustration does not show it, the outside two stacks are connected to the front suspension.

An early example of the rubber cushion in compression, by the action of a simple swinging arm pivoted on the frame of the chassis, is the Harris Leon Laisne front suspension, Fig. 17. In this case the main frame side members are tubular and the suspension and rebound rubber blocks are installed in housings that are fastened on the ends of the members. The swinging arm is a bell crank lever having its fulcrum at a bearing mounted on brackets just above the rubber housing. The short lever of the bell crank extends through a slot in the housing where it links with a shaft that runs through the center of the suspension block. The other end of the shaft is connected to a plate which compresses the larger of the rubber pieces when the wheel moves upward relative to the frame. The smaller rubber part is compressed on the rebound and functions as a shock absorber.

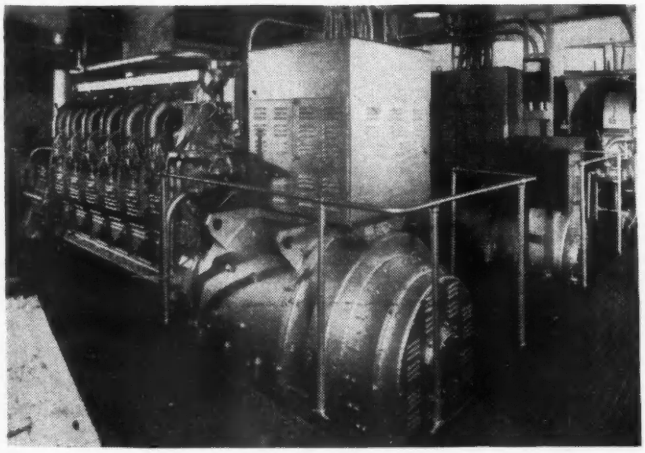
Worker Productivity Appears Linked to Security

Personnel departments of at least two large automobile manufacturers noted an interesting development recently. Careful records showing output per man-hour are kept on all divisions and departments of the two companies. The curve had been running fairly uniform with a slight upward trend for several weeks. Then the week of the stock market break, the line took a sharp turn upward. One spokesman commented that it seemed to bear out the theory that about the only thing that will bring about a return of individual effort on the part of the workers is a certain amount of concern over future job security.

INLAND Ore Freighter First With Diesel-Electric Power

Reconverted and streamlined, with new power, new steering system, new hatch arrangement, increased capacity and a multitude of other improvements, the E. J. BLOCK, of the Inland fleet, recently made her first cargo run, with complete success.

The first lake ore-carrier to be driven by diesel-electric power, the vessel has many revolutionary features, such as hydro-electric steering, direct control of the engines from the bridge, permanent radar installation and new ballast pumps of greatly increased capacity.



Power plant of the E. J. Block consisting of two 1200 horsepower diesels driving electric generators. Either one is capable of propelling the ship.

The changes in this ship, made by American Ship Building Company, make this a most efficient carrier of raw materials for Inland Steel. With the new power system the E. J. BLOCK is one of the fastest vessels of its type. Either of its two main engines is capable of driving the ship under full load. The new steering system, direct engine-control, and radar installations make for a safer vessel. The improved pumps allow ballast to be expelled more rapidly, and in conjunction with the improved hatch arrangements, allow much faster loading of the 11,000 tons of ore, limestone or other materials.

This advancement in raw material transportation is a part of the Inland program of modernization and expansion . . . a program which will continue to supply more and better steel for American industry.

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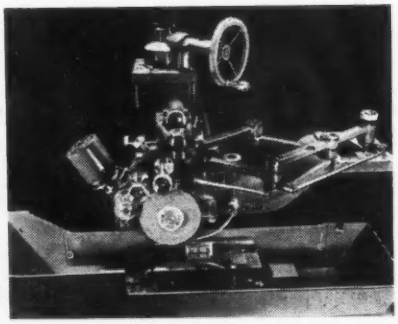
New Production and Plant Equipment

PANTOGRAPHIC diamond form wheel dressing and roll crushing are combind in a single machine, the Moore Panto-Crush wheel dresser, brought out by the Moore Special Tool Co., 740 Union Ave., Bridgeport 7, Conn.

The 2-in-1 Moore Panto-Crush wheel dresser consists of a high-precision pantograph, working directly from a template plus a power-driven roll crusher, both mounted together and always accurately related to the spindle.

The principles embodied in this device may be employed, within reasonable limits, on any type of grinder, either cylindrical or surface, on a wide variety of circular or linear form grinding.

Either wheel dressing method or both may be immediately employed to suit the particular job to be done — roll-crushing for fast, cool grinding and diamond dressing for fidelity or form and fine finish. The operator may switch from one method to the other without disturbing the workpiece setting or the location of either truing device. It is not necessary to raise or lower the wheel spindle for dressing the wheel, yet the wheel spindle may be raised or lowered without losing the relation of the wheel form to the dressing device. The Panto-Crush wheel dresser need not be removed from the surface grinder during conventional surface grinding.



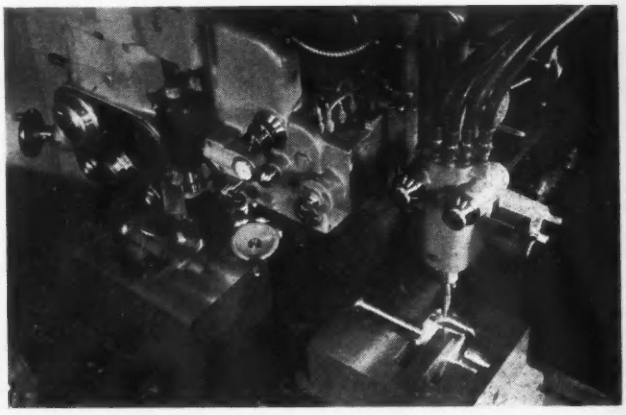
Moore Panto-Crush wheel dresser

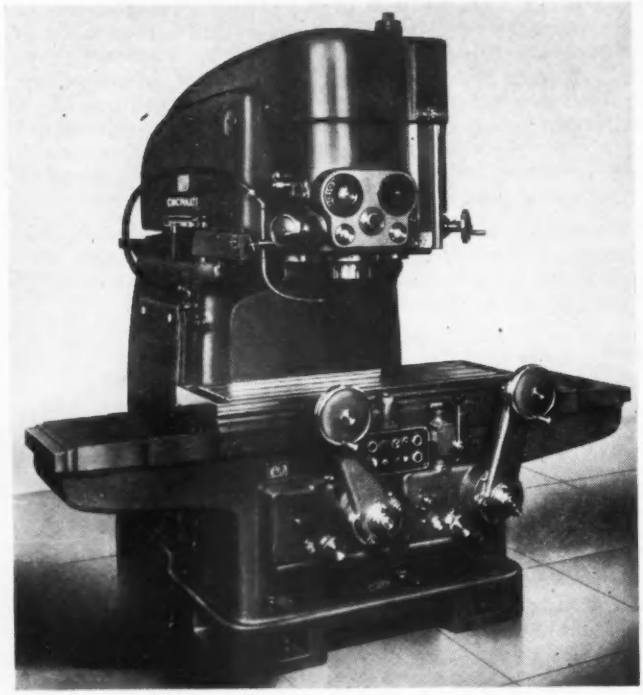
A GENERAL purpose milling machine, the 16 in. Series vertical Hydro-Tel, built by The Cincinnati Milling Machine Co., Marburg and South Sts., Cincinnati 9, Ohio, can be provided with automatic control mechanisms which makes it an efficient automatic die-sinking and profiling machine. The basic machine consists of a fixed height bed cast integral with the rear base. The table is carried in wide-spaced, square gibbed ways on top of the bed, and a heavily proportioned cross-slide unit is similarly mounted on top of the rear base. The vertical spindle carrier unit is mounted in bearing ways on the front face of the cross-slide. The rigidity of this type of structure combined with the ease of operation obtained from hydraulic actuation and control, are said to make the Hydro-Tel an extremely flexible machine having many potentialities. As a consequence, it is built in three distinct styles:

1. A general purpose milling machine. This is the basic machine and is provided with hand and power feeds to the table and cross-slide; hand feed only for vertical positioning of the spindle carrier. This machine is excellent for general purpose work, or for hand controlled die-sinking operations.

2. A die-sinking machine with automatic depth control. This is the basic machine plus an automatic hydraulic tracer mechanism which provides sensitive, automatic duplication of templates or master shapes. This machine may be used for either general purpose work, or for automatic, tracer controlled die-sinking.

Hydro-Tel die sinker





Vertical Hydro-Tel milling machine

3. An automatic 360-deg. profiling machine. This variation is equipped with an automatic, hydraulic 360-deg. profiling mechanism and is supplied for tracer controlled profiling work.

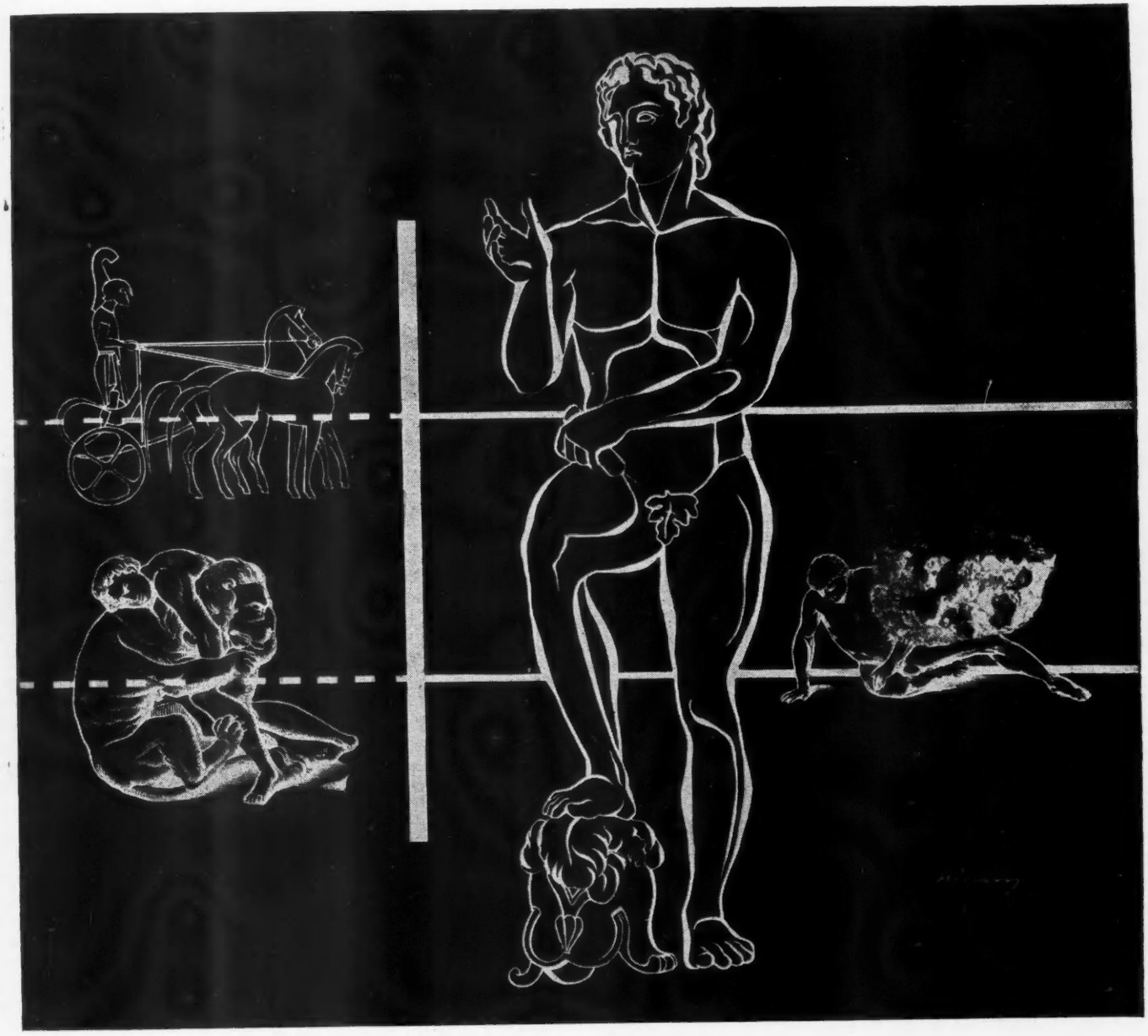
Hand and power feed movements of the sliding elements are hydraulically actuated. Power feed rates are non-related—they are independently controlled and selected and may, if necessary, be used simultaneously at differing rates. They are infinitely variable to permit selection of the exact feed rate desired. Feed rates for both table and cross-slide range from 1 in. to 25 in. per minute. A special feed range of ½ in. to 12½ in. per minute, useful for die-sinking applications, is avail-

(*Turn to page* 76, *please*)

IT TAKES MORE THAN MUSCLE

According to legend, Polydamas, the Greek athlete, killed a lion with his bare hands, stopped a chariot in full flight, and lifted a raging bull off the ground with ease. His career, however, came to a spectacular end when he tried to catch a huge falling rock.

Today, sudden, heavy loads end the life of many steel parts. Low temperatures, for instance, can have a depressing effect on the impact strength of steels. Molybdenum steels, which combine deep hardening and freedom from temper brittleness, reduce this risk.



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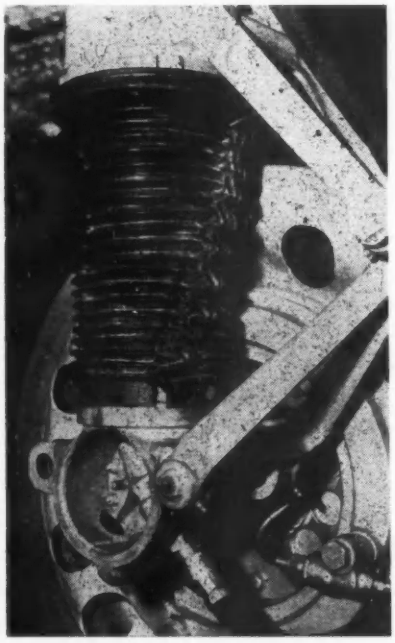
MOLY

New Products for Aircraft

Dust Excluder Boot

A removable dust excluder boot for the landing gear struts of civilian planes has been added to the line of the United States Rubber Co., New York, N. Y. It protects precision-ground cylinders and pistons from the harmful effects of abrasive substances.

The boot is corrugated to provide a bellows-like action, permitting free movement of the pistons. It is split lengthwise and laced to permit quick removal for inspection or replacement. The product is made of high-strength fabric impregnated with oil-resistant synthetic rubber. It has extremely light weight and is produced in a wide range of sizes.

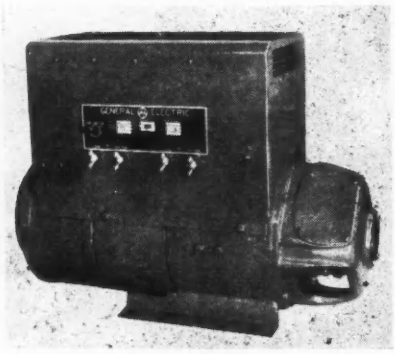


U. S. dust excluder boot

It can also be used to protect moving parts of mechanical equipment used in various manufacturing industries.

Motor-Generator Set For Ground Applications

A light-weight motor-generator set designed for such aircraft ground applications as supplying power for radio and radar testing work, or supplementing batteries for airplane engines has been brought out by the Motor Division of the General Electric Co., Schenectady, N. Y. Called an "energizer," the new set is a 200-amp, 3600-rpm unit,



G-E motor-generator set

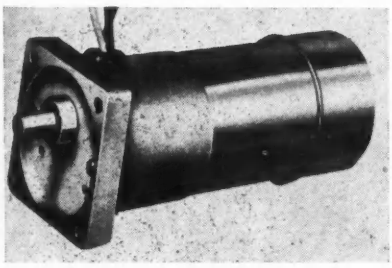
with both motor and generator mounted on the same shaft.

The generator is rated 150 amp continuous, 200 amp intermittent, and 250 amp maximum for 1 min, in either 28.5- or 15-volt designs. The motor is induction type, 3 phase, 60 cycles, and can be designed for any standard a-c low-voltage supply. Control equipment includes an aircraft-type voltage regulator and reverse-current relay, a line switch, load terminals, and a motor starter.

The voltage regulator provides an equalizer connection for parallel operation, and the reverse-current relay affords protection from reversal of generator current when two or more machines are operating in parallel. In addition, when operating with batteries, it connects the generator to the line at the proper generator potential and disconnects it when current is flowing from the batteries to the generator. This prevents the generator from running as a motor if generator voltage should become lower than battery voltage. The manual across-the-line starter has thermal overload protection.

Midget Rotary Actuator

An ultra-lightweight, midget rotary actuator has been developed by Lear, Incorporated, Grand Rapids, Mich., for applications in aircraft and other industries where extreme lightweight and small size are primary considerations. The new actuator, Lear Model 181, which weighs but 0.60 lb, has been designed for loads ranging for 0.1 to 15.0 lb in. and speeds from 2.5 to 375 rpm. With limit switches and AN connector it weighs 0.75 lb.

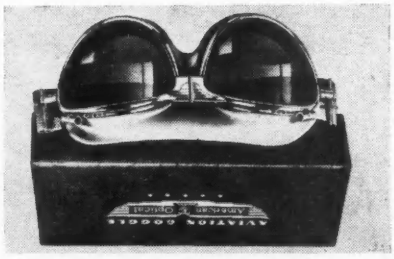


Lear rotary actuator

The Model 181 actuator incorporates the newest Lear motor, the "G" frame, of intermittent duty, split series or single field type, developed for either reversible or continuous rotation. It has output ratings varying from 0.4 to 15 watts at 24 volts direct current. The "G" motor is made in a-c, d-c and universal types for a large range of voltages.

Improved Aviation Goggle

A new aviation goggle has been placed on the market by American Optical Co., Southbridge, Mass. Described as an improvement over A-O's former Transport aviation goggle, the new Airway goggle was developed during the war for the Navy Bureau of Aeronautics.



Airway goggle

Now available for civilians, the goggle's narrow eyewires and newly designed bridge provides the wearer with a greater field of vision as well as better binocular vision. In addition, greater comfort is provided by a new single-piece, chamois-lined mask, another wartime development. Other features include Venturi tubes for controlled ventilation, polished nickel finish of the metal parts, and an extra-long, easily-adjustable headband.

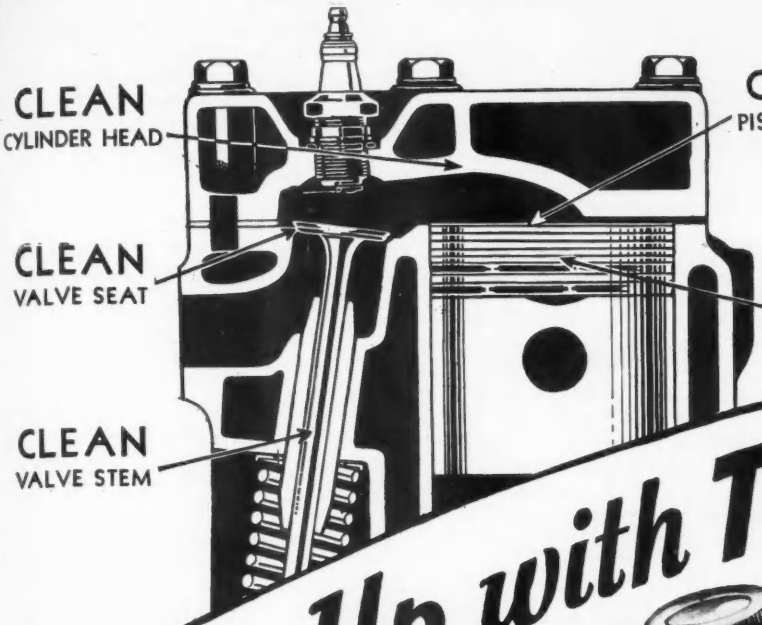
The goggle can be obtained with Calobar "C" glare-reducing, invisible ray absorbing lenses or, if desired, with non-absorbing lenses where glare removal is not essential.

Portable Voltage Regulator

A portable aircraft voltage regulator to accurately balance generator output on all multi-engine planes has recently been made available to the aviation industry by Airquipment Co., Burbank, Cal.

The new instrument has a 2 per cent base accuracy plus a sensitive adjusting mechanism which permits perfect synchronization. It eliminates the danger of "boiling" new batteries. In actual flight, where sufficient loads can be

(*Turn to page* 108, *please*)



Tune-Up with TOON-OYL

by

PERMATEX

Before you Tune-Up MECHANICALLY ... Tune-Up CHEMICALLY!

FIRST, add PERMATEX TOON-OYL to crankcase oil and let car idle. Sludge and gum binders that interfere with the smooth operation of valves, piston rings, oil lines and oil screens, instantly will be dissolved!

THEN you'll have a CLEAN ENGINE, ready for accurate, thorough mechanical adjustments!

Rx

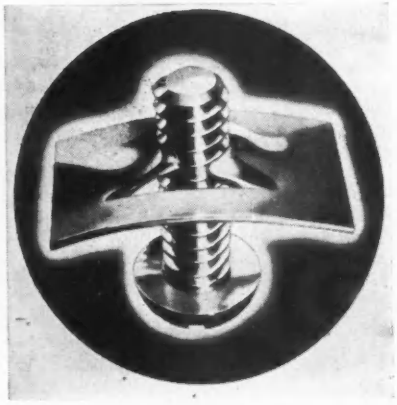
ADD 1 QUART OF PERMATEX TOON-OYL TO 5 OR 6 QUARTS OF ANY TYPE OF MOTOR OIL IN THE CRANKCASE

PERMATEX COMPANY, INC., BROOKLYN 29, N. Y.

New Products

New C7000 Series Speed Nuts

Tinnerman Products, Inc., has developed a new low-priced line of heat-treated, spring steel Speed Nuts. This new line comprises all the sizes required to fit the 10 most popular sizes



Tinnerman C7000 Series Speed Nuts

of machine screws and sheet metal screws. Known as the C7000 Series, this new speed nut line has been engineered to a formula based upon the diameter and strength of the screw with which it is used. It is said that, as a result, these speed nuts are more compact, withstand higher torque tightening and provide greater tensile strength than any flat-type speed nuts ever produced.

New Industrial Adhesive Requires No Catalyst

A new industrial adhesive that requires no catalyst or special preparation for use has been developed by E. I. du Pont de Nemours & Co. A six-months minimum package stability with no tendency to gel inside of a year is said to be an outstanding property of the new cement.

No. 4665 is described as being tough and flexible, suitable for bonding metal foils and metal sheets to wood, plastics, vulcanized synthetic and natural rubbers, as well as other substances having widely different coefficients of thermal expansion.

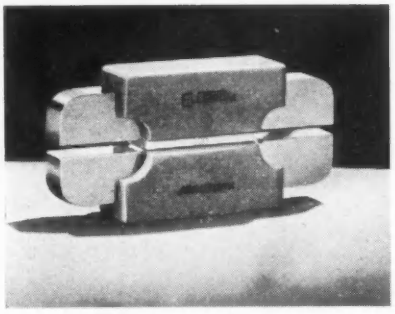
The new cement can be applied without thinning, by brushing, roller coating, knife coating, or dipping. It contains 27.5 per cent solids. Although insoluble in water, its bond strength is lowered by continued immersion. However, original bond strength is regained after removal from water.

The dried adhesive film is resistant to dilute alkalies, acids, and corrosive salt solutions. The Parlin, N. J., laboratory, where the new adhesive was developed, reports that it is not attacked by petroleum or coal-tar solvents, lubricating oils, alcohols, ethylene glycol, or vegetable oils, but is soluable in ketones or ester solvents. Moreover, the cement is resistant to mildew and fungi.

Snap Gage Incorporates Special Gage Blocks

A snap gage incorporating the use of special gage blocks as accurate, non-wearing spaces in working, interchangeable assemblies is the latest addition to the line of Dearborn Gage Co., 22038 Beech St., Dearborn, Mich. The new snap gage, known as the Ellstrom "Mastersnap", consists of a special gage block wrung between a pair of chromium-plated, special alloy-steel jaws and locked in position by brass thumb fasteners. Colored thermo-plastic insulators, green for "go" combinations and red for "no-go" combinations, are fitted over the jaws and held in place by means of plastic pins to complete the "Mastersnap" assembly.

By this arrangement, according to the manufacturer, the special gage blocks are not subjected to wear and may be used indefinitely without loss of



Ellstrom Mastersnap Gage

original accuracy. It is also reported that, by finishing the jaws separately, true flat chromium-plated gaging surfaces are assured.

Special gage blocks for the "Mastersnap" are available in sizes from .050 in. to 2.000 in. inclusive. They may be used separately or in combinations to form a wide range of double-end snap gage sizes. Separate "Mastersnap" assemblies are required for the "go" and "no go" combinations. Of the two sets of "Mastersnap" jaws being offered, the three-in. pair is recommended for sizes under .500 in., while the four-in. jaws are used for sizes over .500 in.

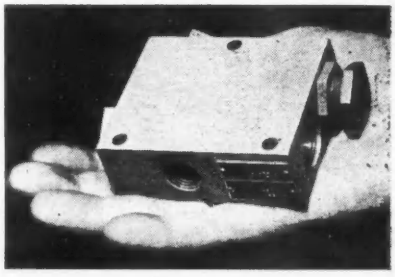
Low-Cost Hydraulic Cut-Out Valve

A new low-cost hydraulic cut-out valve has been placed in production at Electrol, Inc., Kingston, N. Y. Beside the low price, this device is featured by positive seating of the valves, few moving parts, small size, long operating life, low pressure drop, and adaptability to installation in small, narrow and hard-to-reach places.

The housing is only 1¼ in. deep and in plan form measures 2¾ by 3½ in. All four ports—pressure, system, return and bleed—are in the same plane.

Three of the ports—pressure, return and system—are ⅜ in. NPT female ports. The fourth is a ⅛-in. NPT bleed port.

In accordance with the requirements



Electrol cut-out valve

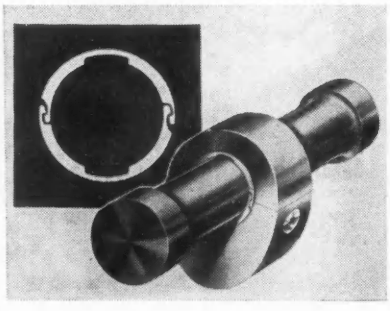
for the installation, cut-out pressures can be supplied from 300 psi up to 1500 psi and the differential pressure can be varied, in relation to the desired cut-out pressure, from 75 psi to 500 psi. An external adjustment for pressure setting is incorporated.

Interlocking Type Retainer Ring

A new retaining ring of two-part interlocking construction, identified as the Truarc interlocking ring Type 5107, has been brought out by Waldes Kohinoor, Inc., 47-10 Austel Place, Long Island City 1, N. Y.

Fitted over a shaft in a radial di-

(*Turn to page* 96, *please*)



Truarc interlocking ring Type 5107

here is the new

AIR-HARDENING TOOL STEEL

that gives you

EASY, LOW TEMPERATURE HEAT TREATMENT

VEGA

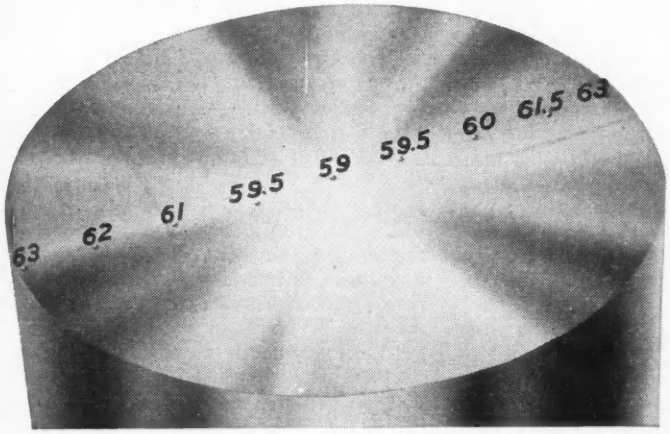
U. S. Pat. 2,355,224

The fact that VEGA can be heat treated from a temperature 200°F lower than the 5% chromium air-hardening steels often eliminates the need for expensive pack hardening to avoid excessive scaling. And because the hardening temperature for VEGA is only 1550°F, no special high temperature furnaces are required. These two advantages alone enable VEGA to do more than "pay its way" in your tool room.

UNIFORM HARDENING IN VERY HEAVY SECTIONS

This new steel combines the deep-hardening characteristics of air-hardening steels with the simplicity of *low temperature* heat treatment. Notice the uniformity of Rockwell hardness values from surface to center of this 8" VEGA round. On your jobs such as blanking, piercing, trimming and forming sheet metal in light and heavy gauges — jobs where minimum distortion and size change, uniform hardening in very heavy sections are required—VEGA gives you long tool life, low production costs.

Inside Rockwell "C" Hardness of Section Cut Midway on 8" Round x 15" Long VEGA. Air Cooled at 1550°F 1 Hour at Heat.



CHECK THESE EXTRA ADVANTAGES YOU GET WITH VEGA

- Minimum Distortion and Size Change
- Resistance to Decarburization
- Freedom from Excessive Scale in Hardening
- Good Machinability
- High Degree of Toughness with Good Hardness to Resist Shock and Wear

This folder contains complete information on VEGA—its properties, heat treatment and use. To put VEGA's new advantages to work in your tool room ask for the new VEGA folder. Just drop us a note on your company letterhead, indicating your title.

THE CARPENTER STEEL COMPANY, 103 W. BERN ST., READING, PA.

Carpenter AIR-HARDENING TOOL STEELS 100% ACID-DISC INSPECTED

Branches at: Buffalo, Chicago, Cincinnati, Cleveland, Dayton, Detroit, Hartford, Indianapolis, New York, Philadelphia, Providence, St. Louis

NEWS *of the* Industry

Automotive Industry Making Poor Start into Last Quarter of Year . . . Sheet Steel Again Appears to be Most Critical Material Shortage . . . Steel Wire, Lead, Pig Iron and Other Basic Materials Still Scarce . . . Truck Production Down During September . . . Automotive Employment Payrolls Highest in Peacetime History . . . Production Troubles Reflected in Kaiser and Frazer Prices.

The automotive industry is making anything but an auspicious start into the last quarter of this year, and there is little cause for optimism over the chances to maintain even the limited levels attained in the third quarter. Basic raw materials are becoming more of a problem every day. With the gradual upswing in production during the third quarter, more and more materials were used up while the sources of supply did not keep pace. That is the principal reason why automotive men do not look for any substantial increase for the rest of this year, and it is altogether possible that the total output may not come up to that of the preceding three-months period. In addition to the shortage of materials, there are several other unfavorable factors that may come into play. Strikes over wages are a possibility late this year. Deer and small-game hunting seasons are expected to result in a high absenteeism again this year, especially with the meat shortage giving added impetus to the hunting urge. Also, the Thanksgiving and Christmas holidays will interrupt production to some extent. Another possibility is that some companies may change models late this year, and although the interruption will be short, it is bound to take some time to taper off on present models and to get into efficient production on new ones.

Steel Shortage Trims Production Schedules

Sheet steel appears now to be the most critical material shortage. Hudson was out of production the first week of this month for that reason. The Cleveland Fisher Body plant is running at only 56 per cent of capacity. Chrysler Corp. announced early in the month that it was being forced to reduce schedules to about 2800 cars and trucks a day because it could not get the steel required for bodies. Production has been estimated to have been running about 3600 a day before the curtailment. The corporation will run as many departments as it can supply with materials and build service parts and parts assemblies to the extent of materials available. A Chrysler statement said that steel has been in short supply since V-J Day and that it has been a serious and limiting shortage since the steel strike. In addition, there is further reduction in steel output now because of work stoppages since the steel strike and also because of the reduction brought about by the Pittsburgh power strike. Although the effect of the tie-up in Pittsburgh on Detroit production schedules is not immediately apparent, it is obvious that it will be felt ultimately. Steel mills still are operating, but under power restrictions which are a factor in holding down production of steel by at least four hours a day. Chrysler cited the Pittsburgh strike as one of several reasons why it was forced to curtail production of cars and trucks, but did not indicate whether this was an immediate or contemplated future factor. Since some production still is going on, and the steel companies may be supplying some needs from inventories, it will be a matter of a few weeks before the effect on automotive schedules can be determined. However, there were other indications which point to a prolonged period of limited output. Briggs Mfg. Co., which builds bodies for Chrysler, is reported to have eliminated one shift in one of its plants and laid off several thousand men at another. Chrysler also has laid off several thousand. Information in Detroit is that the companies told the men they would not be called back until mid- or late November at one Chrysler plant, and until the first of the year at Briggs.

Several Basic Materials Continue in Short Supply

In addition to the shortage of sheet steel, several other basic materials continue in short supply. Steel wire for seat springs and back cushions remains a limiting factor at most companies. Lead is one of the most important shortages at present, and it would not be surprising if some cars and trucks were shipped without batteries this month. Pig iron also remains short. And now the industry has two new shortages of recent origin that threaten to cause trouble. Despite a recent substantial increase in the price of castor beans, the oil from which is used in brake fluid, the supply remains short. Glass also is beginning to show up as a potential bottleneck. Soda ash production is likely to show a drop of about a half million pounds from prewar levels this year and is running short of requirements. Copper is another item which is on a hand-to-mouth basis.

September Production Figures Disappointing

September automotive production figures were disappointing in the light of both August performance and of projected schedules. Passenger car production barely held its own and trucks dropped off about 10,000 units for a total of about 335,000 units in the United States, compared with 346,808 cars and trucks in August. Unofficial production estimates indicate output for September at about 240,000 cars and 95,000 trucks, compared with 241,302 and 105,506 respectively, in August. While it is true that there were two fewer working days in September than in August, that does not fully explain the drop. Actually, during all of September, the industry did not in any week hit the high point of more than 90,000 reached the last week in August. The first week of October, production was up to about 90,000 but did not hit a new mark. Original projections for the month called for nearly 500,000 units, but it now seems certain that the industry will fall far short of that.

Automotive Payrolls At Peacetime High

Although automotive production today is running at about half the rate achieved in 1941, payrolls in the automotive, body, and parts plants are 76 per cent higher than that year and the number of hourly rated workers is up 25 per cent, according to AMA. With payrolls running nearly $36 million a week to 699,000 workers, the industry has hit a new high for peacetime operations. In view of the small production achieved it is small wonder that most companies have encountered operating losses thus far. The increase in the

(*Turn to page 94, please*)

S at the ow...

E CASTINGS

ODD SHAPES—CAST OR BENT

One of the principal advantages of the die casting process is the ability to cast unusual shapes. There are instances, however, where it is more economical to obtain a required contour by a bending operation *after* casting.

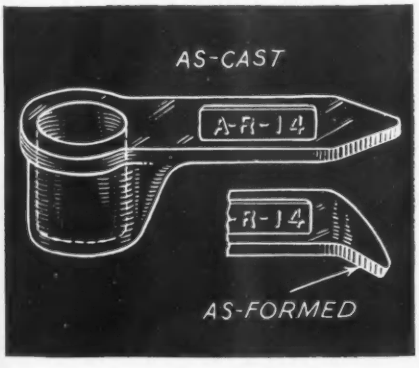
A design change in the *zinc alloy* die casting shown below required that the end of the pointer be curved, instead of straight as it was originally cast. This could easily be accomplished by altering the die but, thanks to the ductility of the zinc alloy, it proved to be less costly and quite satisfactory to bend the pointer after casting. There are many cases where a simple forming operation of this kind will prove to be more economical than to cast a shape which will involve high die cost or slow up the casting cycle.

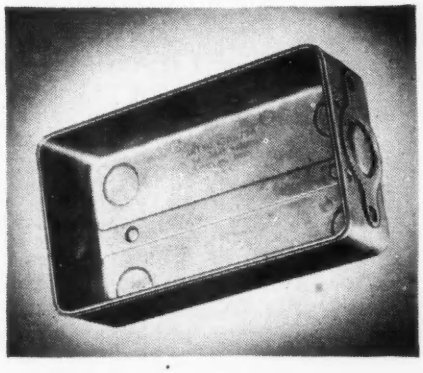
KNOCKOUTS ARE OFTEN PROVIDED IN DIE CASTINGS

Knockouts—thin sections which are later punched out to provide openings—are frequently provided in die castings. The designer of such a part will do well, however, to attempt to so locate the knockouts that they will not constitute undercuts which will interfere with the ejection of the casting from the die.

The *zinc alloy* die cast switch box below has eight knockouts to provide various openings for conduits and screws depending upon the particular type of installation. Six of these knockouts are in the bottom of the box and, since they are parallel to the die parting, they do not constitute undercuts. The knockouts at either end of the casting, however, require the use of slides having about ⅛" motion to clear the casting when it is ejected.

Naturally, the slides necessitated a more expensive die and there is some extra flash to be removed from the castings, but the knockouts are absolutely essential at these points and the extra costs were justified on this score.





Send for your copy

A Few Words About This Advertisement

This is the first advertisement in a new series which will appear in these pages during the months ahead. Because of our close association with the die casting industry, many interesting design and application ideas come to our attention. We propose, in these advertisements, to pass these ideas along to you to help in the solution of some of your problems. Watch for these ads and, in the meantime, ask us—or your die casting source—for a copy of the booklet "Designing For Die Casting"

ZINC

FOR DIE CASTING ALLOYS

The New Jersey Zinc Company, 160 Front St., New York 7, N. Y.

The Research was done, the Alloys were developed, and most Die Castings are based on

HORSE HEAD SPECIAL (99.99 + % Uniform Quality) ZINC

PERSONALS

Recent Personnel Changes and Appointments at the Plants of Automotive and Aviation Manufacturers and Their Suppliers.

Ford Motor Co.—**Lewis D. Crusoe,** Director, newly organized Planning and Control Div. **Charles B. Thornton,** Director, Planning Office.

Perfect Circle Co.—**Macy O. Teetor,** resigned as Vice-Pres. in Charge of Engineering due to ill health. **Daniel C. Teetor** appointed Acting Vice-Pres. in Charge of Engineering, in addition to his present capacity as Vice-Pres. in Charge of Manufacturing.

Aircraft Screw Products Co.—**Charles L. Huisking, Jr.,** Treasurer and Asst. Sales Mgr.

The Lincoln Electric Co.—**C. M. Taylor** elected Executive Vice-President.

Graham-Paige Motors Corp.—**Paul W. Heasley,** Treasurer and **Milton P. J. Hickey,** Asst. Treasurer.

The Young Radiator Co.—**Peter J. Fink,** Service Manager and **Lloyd B. Smith,** Special Representative in Pacific-Northwest territory.

The Ohio Crankshaft Co.—Camshaft and Crankshaft Divs., **Chester H. Kimmel,** Manager, **Morgan R. Kavanagh,** Factory Manager.

Chrysler Corp.—**Charles W. Craig** has joined Public Relations Dept.

United Aircraft Corp., Pratt & Whitney Aircraft Div.—**Henry N. Igo,** Asst. Factory Mgr.; **William P. Cross,** Supt. of Assembly and Test.

United Aircraft Corp.—**Robert C. Treadwell,** Divisional Controller of Hamilton Standard Propellers Div.

The National Screw and Manufacturing Co.—**Eugene E. Griese** has announced his resignation as Secretary and Treasurer. **George R. Kloppman** has been appointed to the vacancy; **Harold H. Hummel,** is Asst. Treasurer and **Richard H. Leukart** replaces Mr. Kloppman as Director of Industrial Relations.

Celanese Corp., Plastics Div.—**John J. Kelville, Jr.,** Director of Product application; **Frank Sanford,** Asst. Director of Molding Materials Dept.

Boeing Aircraft Co.—**Richard M. Morgan,** Manager, Wichita Sales Office. **J. O. Yeasting** has been appointed Assistant to the President; **J. V. Sheehan** and **Ralph Bell** have joined Sales Engineering Staff. **D. A. Forward,** elected to Board of Directors; **Major General H. R. Oldfield** becomes Project Supervisor, Engineering Staff.

Douglas Aircraft Co., Santa Monica Plant—**L. W. Tixier,** Manager of Industrial Relations.

Ryan Aeronautical Co.—**Henry A. Sutton,** Asst. to President and Engineering Adviser.

Luscombe Airplane Corp.—**James P. Cunningham,** Vice-Pres. in charge of production.

Menasco Manufacturing Co.—**Henry C. Hill,** Asst. Director of Power Plant Engineering.

Consolidated Vultee Aircraft Corp.—**J. M. Gwinn, Jr.,** Chief Engineer of Personal Aircraft, has resigned.

Jos. T. Ryerson & Son, Inc.—**Frederick A. Purdy,** Mgr., new Los Angeles plant.

Indian Motocycle Co.—**A. F. West** and **William W. Vivian,** appointed sales managers.

Cummins Engine Co., Inc.—**Leonard** W. Beck, Acting General Sales Manager.

The Federal Machine and Welder Co.—**E. C. Coombs,** Asst. Sales Manager.

Koppers Co., Inc., Aeromatic Aircraft Propeller Dept.—**Harold R. Uhrich,** Chief Analytical Engineer, and **Vernon B. Benfer,** Sales Engineer.

Peninsular Grinding Wheel Co.—**James M. Surbrook,** elected Vice-Pres. in addition to his present position as Treasurer.

Perfex Corp., Radiator Div.—**H. Russell Wilson,** Sales Manager, and **Ernest H. Panthofer,** Chief Engineer.

Electric Machinery Manufacturing Co., Subsidiary of Worthington Pump & Machinery Corp.—**Thomas Cruthers,** elected a member of the Board.

Lear, Inc.—**William F. Frankart,** Senior Radio Project Engineer.

Modern Collet and Machine Co.—**Henry Hillerman,** Sales Manager.

Nash-Detroit Company, **O. L. Arnold,** formerly asst. General Sales Manager of Nash Motors, elected President.

Peninsular Grinding Wheel Co.—**C. Edward Price,** elected President.

Personal Aircraft Shipments

(Excluding helicopters and gliders)

COMPANY	COMPLETE AIRCRAFT				VALUE (In Thousands)			
	Shipments		Unfilled Orders		Shipments		Unfilled Orders	
	August	July	August	July	August	July	August	July
Aeronca	798	793	4,462	4,189	$1,422	$1,444	$3,632	$7,780
Beech	20	20	53	48	1,228	1,172	3,228	2,867
Cessna	547	481	914	782	1,275	1,122	2,118	2,051
Luscombe	280	193	N.A.	N.A.	650	455	N.A.	N.A.
Piper	798	710	11,993	12,770	1,407	1,227	24,539	26,189
Republic	20	.....	5,126	5,150	98	(a)	(a)	(a)
Stinson	245	121	1,940	2,355	980	484	7,760	9,420
Taylorcraft	518	318	1,725	1,900	1,036	636	3,400	3,800
Texas Eng. and Mfg.	121	52	1,582	1,703	458	218	3,587	3,615
*Total—Reporting members of PAC	3,347	2,688	27,795	28,897	$8,554	$ 6,758 (b)	$53,264 (b)	$55,722 (b)
Estimated Total—All Personal Aircraft Mfgrs.	4,350	3,363	48,155	47,742	N.A.	N.A.	N.A.	N.A.

N.A.—Not available. (a)—Combined with total for Airliners. (b)—Excludes Republic.
*—Total covers only members of the Personal Aircraft Council of the Aircraft Industries Association, as reported by the Personal Aircraft Council.

July New Truck Registrations

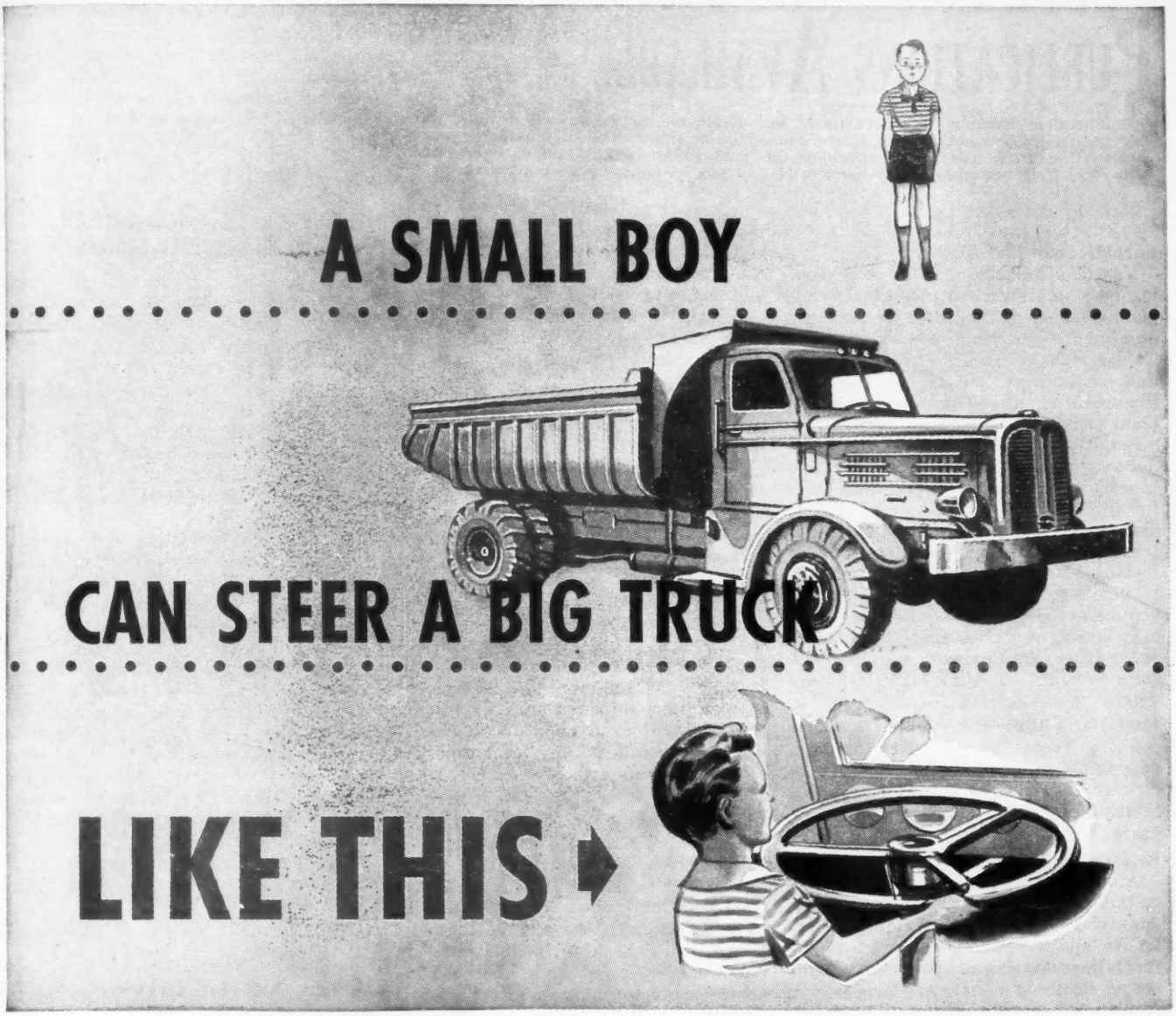
Make	July 1946	June 1946	July 1941	Seven Months 1946	Seven Months 1941	Per Cent Change	Per Cent of Total Seven Months 1946	Per Cent of Total Seven Months 1941
Chevrolet	18,754	15,816	22,893	65,236	142,076	− 54.1	22.92	33.71
Ford	5,313	4,579	18,122	59,611	120,516	− 50.5	20.95	28.60
Dodge	8,686	8,796	6,629	53,961	38,621	+ 39.6	18.95	9.16
International	7,767	6,249	9,531	38,548	59,204	− 35.0	13.54	14.05
Willys-Jeep	4,189	3,742	226	19,245	1,210	+1490.0	6.76	.29
Studebaker	3,147	2,447	526	10,866	2,736	+ 297.0	3.82	.65
G.M.C.	1,773	1,093	4,543	7,515	27,290	− 72.4	2.64	6.48
White	583	761	1,047	5,170	5,733	− 9.7	1.82	1.36
Reo	988	545	150	4,646	903	+ 415.0	1.63	.21
Mack	269	287	1,055	3,960	5,741	− 31.0	1.39	1.36
Diamond T	99	167	595	2,910	3,830	− 24.0	1.02	.91
Autocar	459	373	262	2,456	1,520	+ 61.6	.86	.36
Federal	401	372	158	2,444	933	+ 162.0	.86	.22
Brockway	334	255	250	2,092	1,360	+ 53.8	.73	.32
Divco	305	257	264	2,064	1,438	+ 44.0	.72	.34
Hudson	235	345	71	1,436	548	+ 162.0	.50	.13
F.W.D.	51	43	28	323	149	+ 117.0	.11	.04
Sterling	34	41	54	310	279	+ 11.1	.11	.07
Plymouth	1	5	863	11	6,510	− 99.8	.....	1.54
All Others	269	315	145	1,921	860	+ 123.0	.67	.20
Total	53,657 p	46,488	67,412	284,725	421,457	− 32.3	100.00	100.00

Source of data—R. L. Polk & Co.

Borg-Warner Buys Plant For Transmission Division

Borg-Warner Corp. has purchased from the War Assets Administration the manufacturing plant in Milwaukee County, Wis., which during the war was operated by the A. O. Smith Corp. for the production of airplane propellers. The purchase price was approximately $1,500,000.

The plant is intended for use by the Corporation's newly-formed Wisconsin Transmission Division. It will not be fully equipped and ready for operation until the latter half of 1947.

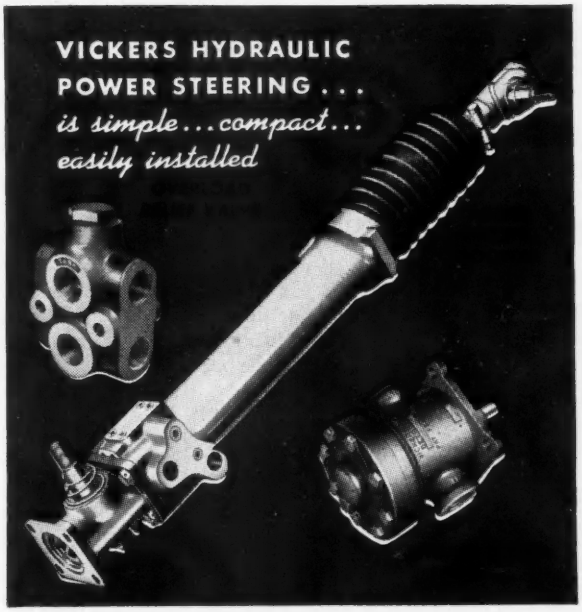


with VICKERS Hydraulic POWER STEERING

We don't expect a small boy to drive a big truck, but his strength is many times equal to the steering effort required if the truck has Vickers Hydraulic Power Steering. The steering wheel turns with effortless ease, and the front wheels always follow *exactly*.

Moreover, no matter how rough the ground, no road shock can get to the driver. The steering wheel cannot spin, or jerk—the vehicle can be driven over the curb or through sand with no "fight" from the wheel. A flat tire will not cause swerving. The driver is relieved of the most fatiguing part of his job—enabling him to work faster and longer with greater safety.

Vickers Hydraulic Power Steering is simple, compact, easy to apply to existing chassis designs. It has automatic protection against abuse and excessive steering reaction forces. Lubrication is automatic. Fifteen years of successful operating experience on trucks, buses, road machinery, etc. have proved the value of Vickers Hydraulic Power Steering. Write for Bulletin 44-30.



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Publications Available

Publications listed in this department are obtainable by subscribers through the Editorial Department of Automotive and Aviation Industries. In making requests give title above the item concerning the publication desired, the date of issue in which it appeared, your name and address, company connection and title.

Carbide Tools and Blanks

Vascoloy-Ramet Corp.—32-page catalog on improved carbide tools and blanks designed to meet the tool requirements of post-war production. Tables and technical data are included and, in addition, the catalog lists and illustrates about 500 standard tools and blanks, many of which are new or revised items. Ten pages of tool engineering information is given and facts concerning coolants, speeds and feeds for turning, facing, boring and milling various kinds of steel, cast iron, nonferrous metals and non-metallic materials. Tables suggesting angles for turning tools and milling cutters, recommended thickness of tool tips, etc., and instructions and formulae in calculating horsepower requirements for cutting various materials are given.

Multiple Drilling and Tapping

Ettco Tool Co., Inc.—New bulletin describing and illustrating the Ettco-Emrick System and Equipment for multiple drilling and tapping of small parts.

Resistance Welding

Ampco Metal, Inc.—A new, enlarged edition of Bulletin 68-A describing Ampcoloy Resistance Welding Electrodes and alloys. Diagrams and information covering a new line of water cooled electrode holders are included. A number of spot welder tips is offered, together with an enlarged list of seam welder wheels.

Diesel Crawler Tractor

Allis-Chalmers Mfg. Co. — 32-page catalog on its HD-14 Diesel Crawler Tractor. Included are photographs of the tractor in action and cutaway views of important parts. Special pages are devoted to allied equipment, auxiliary attachments and specifications.

Soluble Oil

Oakite Products, Inc. — 20-page manual describing the advantages and economies of Oakite Soluble Oil in machining, cutting, grinding and related operations on ferrous and nonferrous metals. A discussion of various Oakite addition agents used to meet unusual and special machining problems is included, and helpful information concerning correct mixing procedures for coolants.

Rayon Cord in Tires

American Viscose Corp.—The facts about rayon cord in tires, based upon results of laboratory and road tests on cords and tires, is summarized in an informative booklet, The Record of Rayon Cord in Tires. The booklet explains first the functions of both the cord and the tire itself then sets forth the proved characteristics of both rayon and natural cords. Tire performance is analyzed in non-technical terms and such aspects as mileage, impact and heat resistance are explained in terms of tire construction.

Lead Measuring Instrument

The Fellows Gear Shaper Co.—Circular on No. 12H lead measuring instrument for checking the accuracy of helical and other surfaces. The booklet is well illustrated and contains many diagrams and information regarding adjustments, specifications and capacities, weights, dimensions, standard and special equipment.

Stainless Steel Tubing

Summerill Tubing Co. — Folder, A Guide for the Selection of Seamless and Redrawn Welded Stainless Steel Tubing, contains information consisting of characteristics and applications, analyses, mechanical and physical properties of seven stainless steels made by the company.

Fluid Catalytic-Cracking Process

The M. W. Kellogg Co.—Brochure, Fluid Progress, describes the major improvements made in basic design in the Fluid Catalytic-Cracking Process of oil refining since the end of the war. The 16-page booklet is illustrated in color and black and white and contains a two-page color diagram of the process showing all major design improvements to date, which are described in detail in the text.

Filters

Wm. W. Nugent & Co., Inc.—A new bulletin covering the use of pressure and gravity filters for coolants and cutting oils. The bulletin describes ways and means for conserving oils, as well as for protecting cutting tools against excessive wear.

Welding

American Welding & Mfg. Co.—16-page bulletin, American Welding, describing the facilities and production of the company. Photographs picture welding, heat-treating, fabricating and research activities and show many product examples of the application of controlled-technique welding.

Motor Car Pioneers to Hold Seventh Annual Reunion

Pioneers of the automobile world comprising the Automobile Old Timers will celebrate its Seventh Anniversary at the annual meeting and luncheon to be held in New York, Nov. 20.

Upon this occasion five prominent personages of the automobile world will receive Distinguished Service Citations including Charles W. Nash, Ralph De Palma, Arthur Lee Newton, Col. Herbert W. Alden and Robert J. Schmunk.

The luncheon, which will be preceded by a reception at noon, will be presided over by President George Conrad Diehl, past president of the American Automobile Association.

The pioneers group has nearly tripled its membership since the last annual meeting in 1944, and a record attendance is predicted upon the occasion of the celebration of its Seventh Anniversary.

David C. Fenner, Alfred Reeves, Arthur Lee Newton, President George Conrad Diehl, ex-officio and Secretary Frederick H. Elliott comprise the committee on arrangements for the gathering.

Bendix Aviation Decides Against Building Planes

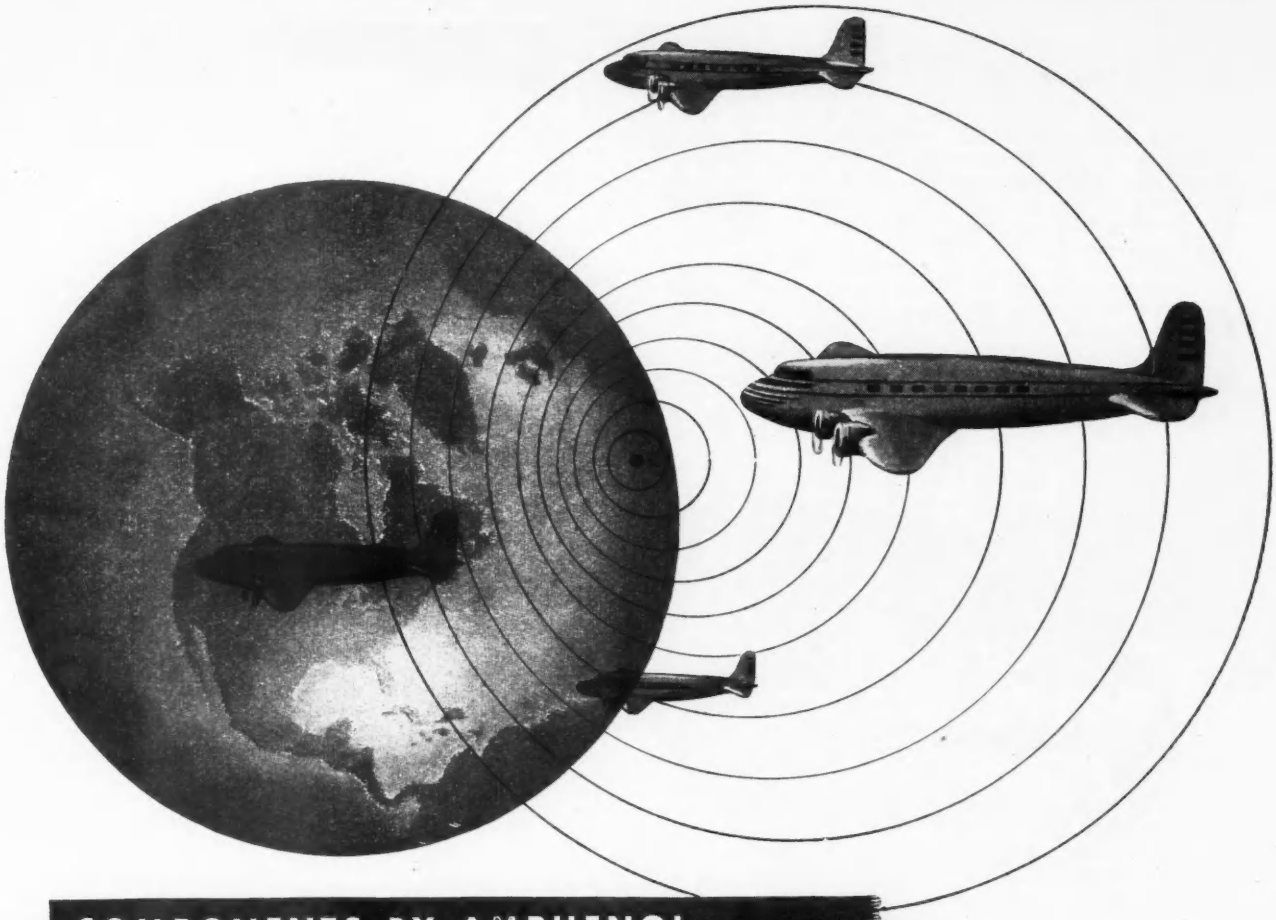
Bendix Aviation Corp. has decided to proceed no farther with an experimental program from which had evolved the design and production of prototypes of two personal airplanes, according to an announcement by Malcolm P. Ferguson, president of the corporation.

The corporation will continue as a producer of those parts which it has long supplied to the industry and will place added emphasis on similar equipment for the personal plane market.

Exports of Aircraft and Engines, 1946

Month	Airplanes (powered and without engines)		Aircraft Engines	
	Number	Value (thousands)	Number	Value (thousands)
January	96	$ 927	59	$ 280
February	89	1,534	72	460
March	117	3,501	200	1,106
April	160	5,488	102	828
May	178	10,419	261	1,588
June	202	10,549	177	1,326
July	213	4,729	223	580
First 7 months	1,055	$37,147	1,099	$6,168

Source: Bureau of the Census.

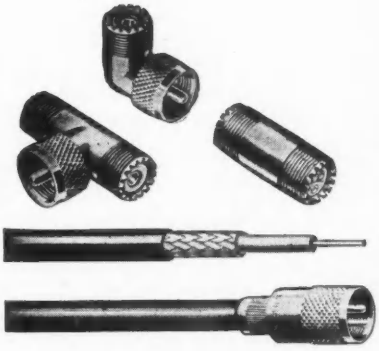


COMPONENTS BY AMPHENOL . . .

fly the World Airways!

The Amphenol name flies the skies of the world, not only in American planes, but in foreign commercial planes as well. All during the war Amphenol furnished the largest portion of the cables, connectors and plugs for communications and radar equipment used in Allied planes. Today Amphenol continues to be the world's largest single source for these components.

From the standpoints of safety and efficiency of operation, complete dependability of communication is absolutely essential in the air. Amphenol components for airborne radio and electronic equipment have these surpassing qualities by all standards of precision manufacture and electrical correctness —in all indicated applications.



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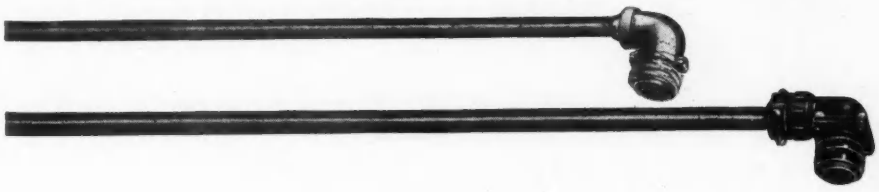

Tucker Torpedo

This view of the rear-engine Tucker Torpedo shows new design features including a curved rear window which extends around the top, and doors which open into the roof. The car is powered by a six-cylinder opposed engine with aluminum block and head, and low-pressure fuel injection. Hydraulic torque converters transmit power directly from the engine to the rear wheels. Brakes are disk type. Wheelbase is 126 in.

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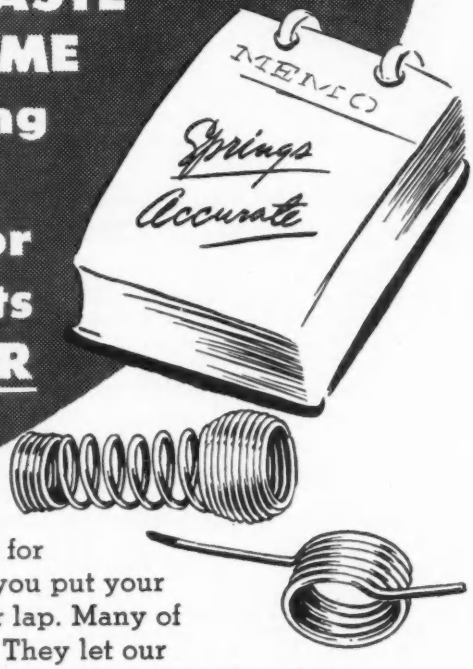
DON'T WASTE YOUR TIME worrying about springs for your products ...that's OUR business...



YOU have more time for more things when you put your spring problems in our lap. Many of our customers do this: They let our engineers design the springs best suited to their particular jobs . . . they tell us when they need them . . . and how many. And that's all there's to it. ¶ They've learned from experience that the springs will be delivered on time . . . that they will be *right* . . . and that the price will be fair. ¶ That's our service policy: to make your spring buying as easy as possible. Try us.

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ACCURATE SPRING MANUFACTURING CO., 3811 W. LAKE ST., CHICAGO 24, ILL.

CALENDAR

Conventions and Meetings

SAE Natl. Transportation and Maintenance Meeting, Chicago .....Oct. 16-17
Armour Research Foundation Conference on Hydraulic Machinery, Chicago .....Oct. 22-23
Amer. Soc. Body Eng. Technical Meeting, Detroit .....Oct. 23-25
Natl. Tool & Div. Mfgrs. Assoc. Convention, Chicago .....Oct. 23-26
SAE Natl. Fuels & Lubricants Mtg., Tulsa .....Nov. 7-8
American Battery Manufacturers Annual Fall Session, Chicago.....Nov. 7-9
Natl. Aircraft Show, Cleveland..Nov. 15-24
French Aero Show, Grand Palais, Paris Nov. 15-Dec. 1
American Welding Society Annual Meeting, Atlantic City .....Nov. 17-22
American Assoc. Motor Vehicles Adm. Annual Mtg., San Francisco..Nov. 18-21
Natl. Metal Congress and Exposition Atlantic City .....Nov. 18-22
Automobile Old Timers Annual Mtg., New York .....Nov. 20
SAE Natl. Air Transport Engineering Mtg., Chicago .....Dec. 2-4
National Wheel, Rim Assoc., Annual Meeting, Chicago .....Dec. 4-7
Natl. Standard Parts Assoc. Conv., Atlantic City .....Dec. 6-7
Motor & Equip. Wholesalers Assoc. Convention, Atlantic City .....Dec. 6
Society for Experimental Stress Analysis, Annual Mtg., New York..Dec. 9-11
Automotive Service Industries Show, Atlantic City .....Dec. 9-14
Int. Aviation Celebration & Exhibition, El Paso .....Dec. 12-15
SAE Annual Mtg. & Eng. Display, Detroit .....Jan. 6-10
Amer. Soc. for Testing Materials—Spring Mtg., Phila. .....Feb. 24-28

OPA Sets Prices for Jeep Station Wagon

Maximum prices for a Jeep station wagon being manufactured for the first time by Willys Overland Motors, Inc., have been announced by the Office of Price Administration. The retail list price for the station wagon without an overdrive and some deluxe equipment is $1337. With this equipment it is $1447.

As in sales of all other passenger automobiles, the retail sales price will be the retail list price plus charges for transportation, federal excise taxes, preparing and conditioning charges, any state and local taxes, gasoline, oil and anti-freeze.

What do You Mean, It Can't Be Done?

A truck manufacturer, working on his postwar model, suddenly discovers he needs an inner oil seal for the rear axle that he thought he could get along without. He used "Perfect" Oil Seals before and calls for help. Within one week of that phone call, the first shipment of "Perfect" Oil Seals (enough for the pilot run) was on the way.

Another manufacturer, suffering from material shortage headaches, asked if we could help him out when his original source of supply could not deliver. Within ten days, shipments of "Perfect" Oil Seals were started—shipments to cover his production of 30,000 machines a month.

We don't offer to pull rabbits out of the hat, but for 16 years, Chicago Rawhide has controlled all the materials necessary for making oil seals except the production of strip steel. Consequently, Chicago Rawhide is in a better than average position to help you if you need Oil Seals.

CHICAGO RAWHIDE MANUFACTURING COMPANY

PHILADELPHIA • CLEVELAND • NEW YORK • DETROIT • BOSTON • PITTSBURGH • CINCINNATI

67 YEARS MANUFACTURING QUALITY MECHANICAL LEATHER GOODS EXCLUSIVELY AND NOW SIRVENE SYNTHETIC PRODUCTS

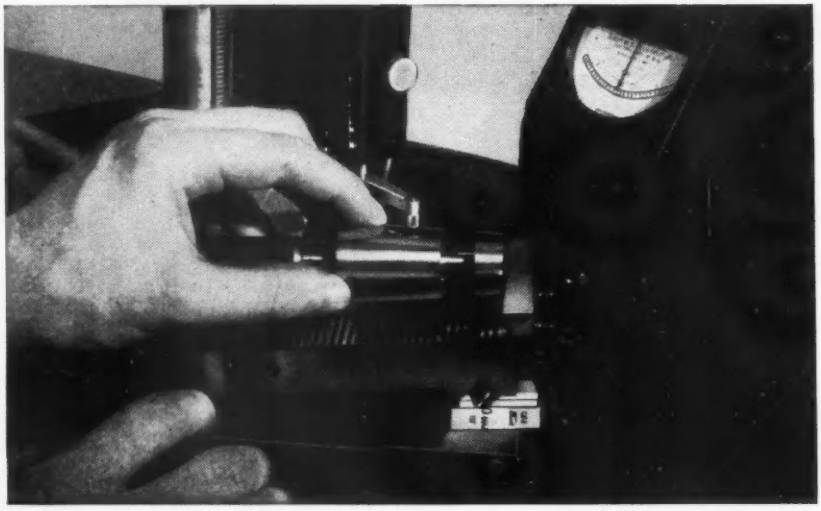
ASTE Forced to Cancel Semi-Annual Convention

The American Society of Tool Engineers was forced, due to power, hotel and other strikes, to cancel its Semi-Annual Convention, scheduled for Pittsburgh, Pa., Oct. 10, 11 and 12.

Telegrams calling off the meeting, which was expected to be the largest Semi-Annual Convention in the organization's 15-year history, were sent to all ASTE members in every one of the 48 states, Canada and several foreign countries.

Tentative plans have been made for the Board of Directors and several of the Society's committees to hold their semi-annual sessions Oct. 25, 26 and 27, at the Fort Shelby Hotel, Detroit. The Central Office of the ASTE is located in Detroit. The Editorial, Educational, Judicial and Membership Committees will meet on Oct. 25. The Board of Directors will be in session Oct. 26 and 27. Complete details of these meetings will be announced as soon as final arrangements have been made.

The next scheduled national meeting of the American Society of Tool Engineers will be the Annual Convention to be held at Houston, Texas, in March of 1947.



a ten-thousandth is routine . . . where JO-BLOCKS control by *millionths!*

It PAYS to control parts-dimensions to close limits. It pays in ease of assembly, in product performance and in the assured fit of replacement parts. In wartime, it paid richly in human lives saved. JO-BLOCKS, the pioneer precision controls, produced in America by Ford Motor Company only, for all industry, are warranted accurate to .000002″, .000004″ or .000008″ ±, and are available in sets at $23 and upward, or in individual blocks, with various accessories. With properly selected genuine Jo-Block equipment, accuracy control can be maintained to the highest practical degree over any mechanical dimensional inspection.

FREE—NEW CATALOG! Profusely illustrated, with full details, covering selection, use and care of Jo-Blocks. Write Ford Motor Co., Johansson Div., Dept. 301, Dearborn, Michigan.

Ford Johansson GAGE BLOCKS

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE *and* AVIATION INDUSTRIES

Moderate further reductions in general business activity are indicated. The *New York Times* index for the week ended Sept. 21 stands at 132.9, as against 134.5 for the preceding week and 121.7 a year ago.

Sales of department stores during the week ended Sept. 28, as reported by the Federal Reserve Board, equaled 257 per cent of the 1935-39 average, as compared with 280 per cent in the week before. Sales were 23 per cent above the corresponding distribution a year earlier, as against a preceding similar excess of 27 per cent. The total in 1946 so far reported is 31 per cent greater than the comparable sum in 1945.

Electric power production increased slightly in the week ended Sept. 28. The output was 11.9 per cent above the corresponding amount in 1945, as compared with a like advance of 12.1 per cent shown for the preceding week.

Railway freight loadings during the same period totaled 916,483 cars, 1.9 per cent more than the figure for the week before and 10.1 per cent above the corresponding number last year.

Crude oil production in the week ended Sept. 28 averaged 4,777,500 barrels daily, 2350 barrels more than the preceding average and 420,050 barrels above the comparable output in 1945.

Production of bituminous coal and lignite during the week ended Sept. 21 is estimated at 12,335,000 net tons, 2.9 per cent below the output in the week before. The total production in 1946 so far reported is 12 per cent less than the corresponding quantity in 1945.

Civil engineering construction volume reported for the week ended Oct. 3, according to *Engineering News-Record*, is $133,719,000, or 59 per cent above the preceding weekly figure and 79 per cent above the comparable sum in 1945. The total recorded for forty weeks of this year is 168 per cent more than the corresponding amount in 1945. The increase in private construction is 308 per cent, and the rise in public construction is 77 per cent.

The wholesale price index of the Bureau of Labor Statistics for the week ended Sept. 28 is 124.4 per cent of the 1926 average, as compared with 123.8 for the preceding week and 105.0 a year ago.

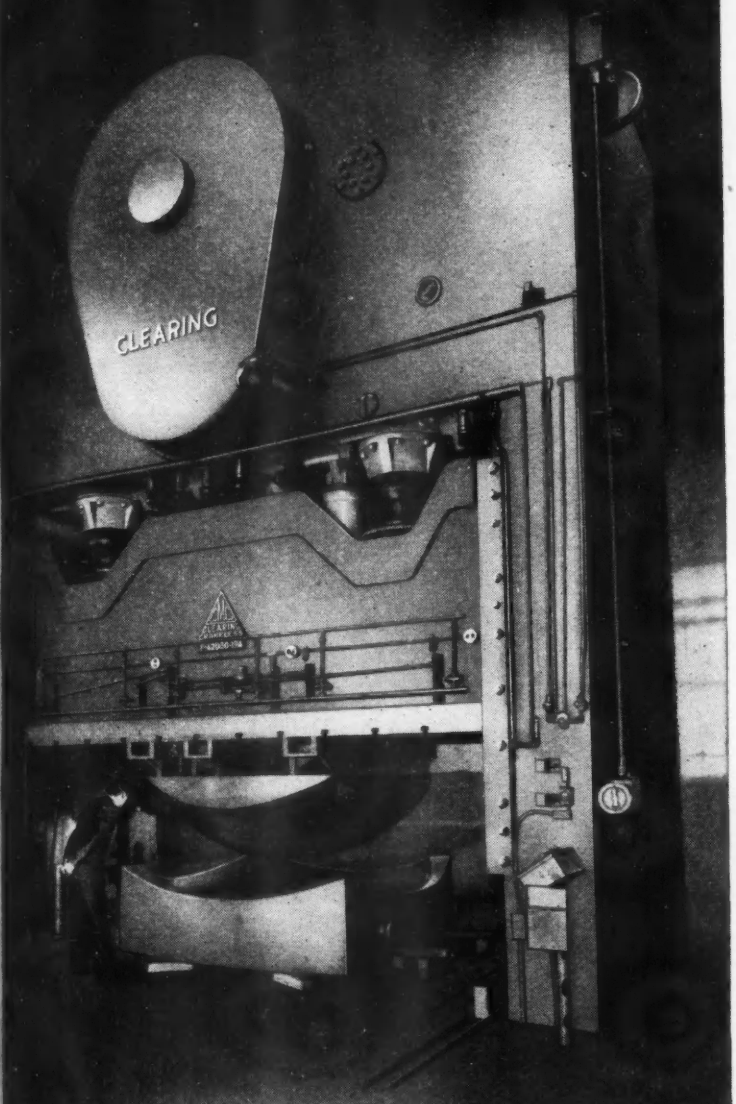
Member bank reserve balances increased $191,000,000 during the week ended Oct. 2. Underlying changes thus reflected include a decrease of $445,000,000 in Reserve bank credit and a decline of $571,000,000 in Treasury deposits with Federal Reserve banks, accompanied by an increase of $78,000,000 in money in circulation.

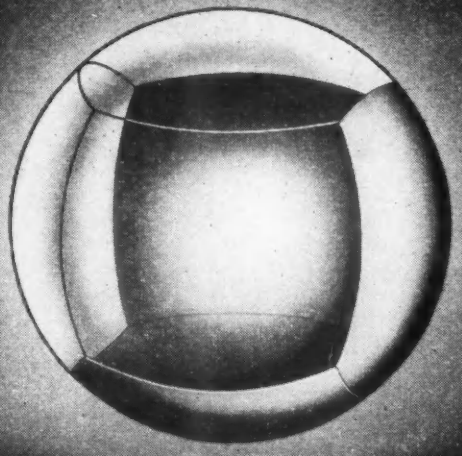
Total loans and investments of reporting member banks declined $334,000,000 during the week ended Sept. 25. rise of $145,000,000 in commercial, industrial and agricultural loans was recorded. The sum of these business loans, $9,070,000,000, shows a net increase of $2,957,000,000 in twelve months.

Knudsen Chairman of Hupp

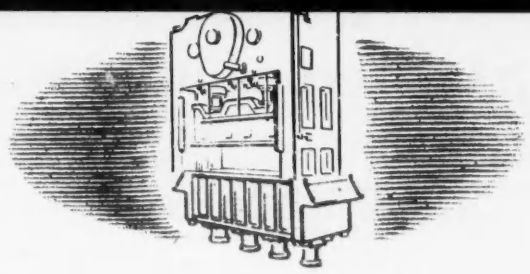
Wm. S. Knudsen, who last June became a member of the Board of Directors of Hupp Corp., has been elected Chairman of the Board, according to Willard F. Rockwell, retiring chairman, who remains as a director.

This 2,000-ton Clearing mechanical press has a 30″ stroke, and operates at either 1 or 3 strokes per minute. Bed area is 96″ x 194″; shut height is 60″. Four double 32″ cushions with 15″ stroke (below the floor level in the picture) give a total cushion capacity of 321 tons. Four 16″ locking devices and pneumatic flywheel brake are also part of the equipment.





Segments are formed as shown in the photo, then flame beveled for welding into a complete sphere of 126″ inside diameter. Each individual segment as it comes from the press weighs nearly a ton.



Cold Forming 3/4″ Plates for 10′6″ Spheres

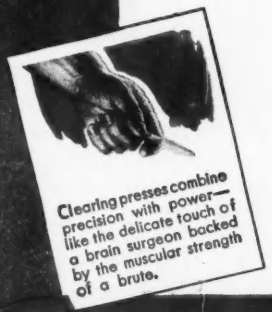
To hold propane and other gases under sufficient pressure to keep them as liquids for compact storage is a job calling for engineering—and manufacturing facilities—of the highest order. Spherical tanks have certain technical advantages, but their production involves an exacting forming operation on heavy plates—flange quality steel of 55,000 p.s.i. tensile strength, .75″ minimum thickness, and 101 inches square.

The Commercial Shearing and Stamping Company, Youngstown, Ohio, are forming such plates on the Clearing press (2,000 tons capacity) shown in the illustration. The six finished segments to make a complete sphere are assembled with only 78 lineal feet of weld. The result saves more than 35% of the material needed for a cylindrical tank to provide equal capacity.

Clearing presses have long played an important part in the production of better items at lower costs, because Clearing makes engineering dreams come true. If you need a huge press of tremendous strength, Clearing can provide it. With small presses or large, if your work demands extreme precision, unusual flexibility of control, high operating speeds or special cycling—Clearing has the answers.

If you want to do something that has never been done on a press before, you will find kindred spirits, well fortified with experience, at Clearing.

It will pay you to consult Clearing on your prospective production problems. There is no cost or obligation involved in doing so.



Clearing presses combine precision with power—like the delicate touch of a brain surgeon backed by the muscular strength of a brute.

CLEARING

THE WAY TO EFFICIENT MASS PRODUCTION

CLEARING MACHINE CORPORATION

6499 WEST 65TH STREET CHICAGO 38, ILLINOIS

SAE Aeronautical Meeting

(*Continued from page* 17)

with "typical airline passengers," to all possible outside weather conditions. A careful check of personal reactions to different cabin temperatures, air velocities, humidity and air freshness established the zones of comfort desired. Del Mar's recommendations included a dual air supply from cabin superchargers providing 20 cubic feet per minute per passenger, air cycle refrigeration of moderate capacity capable of operation on the ground or in flight, use of 100 per cent fresh air rather than recirculation, provision for ground ventilation with or without engines running, and optional fresh water humidification equipment.

Pulsating-jet engines, of the type which drove the Nazi buzz bombs, merit consideration for more constructive uses, according to L. B. Edelman, Navy Department, of Project Squid, Princeton University. His paper traced the development of the pulsating engine from its conception, as a proposed improvement over rocket augmentation schemes, to engines whose construction and performance were known in the summer of 1946. A number of uses for pulsating-jet engines were suggested because of the outstanding inherent advantages in design and performance of this type engine:

1. Mechanical design is by far the simplest and least expensive known for operation statically and at forward speeds up to well in excess of half sound speed. Present and contemplated designs do not require specialized high temperature alloys or expensive machining operations.

2. Starting, throttling, and shutdown are dependable and easy to effect; a simple ignition system is required only for starting; control is dependent only on fuel flow, and not on external governors or other auxiliaries.

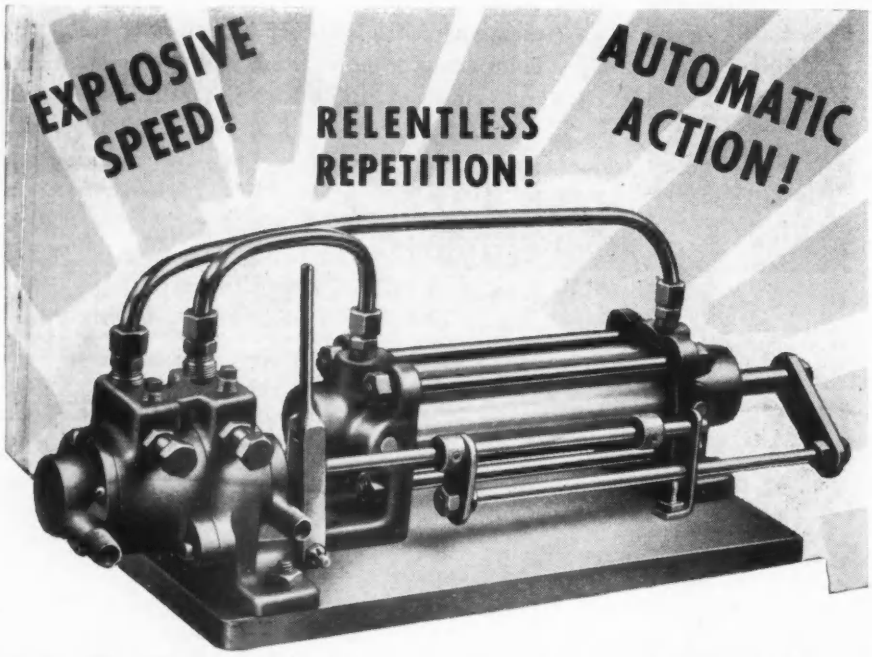
3. Any common liquid fuel may be used without redesign or change in parts, and without noticeable performance variation.

4. Dry weight is favorable in comparison to all air-consuming engines throughout a wide speed and altitude range.

Undesirable features of present designs, Mr. Edelman pointed out, are the relatively high fuel consumption, the best figure to date being about 2.6 lb per hp-hr under static conditions; noise and vibration in operation are unpleasant, though not generally dangerous or destructive; and operating life of the valve elements is short.

"Development of Chrome Plated Piston Rings for Aircraft Engines," was presented by John B. Minnich, Asst. Project Engineer, Wright Aeronautical Corp. The object of developing chrome plated piston rings is to extend the operating life of ring assemblies by improving the top compression rings. The development work by Wright Aeronautical Corp. suggests that the general durability of compression rings can be greatly extended by adding chromium plate to the ring periphery. He pointed out that the type of plating, porous or hard, does not appreciably affect the rate of ring or barrel wear or the general performance of the combination; that adding chrome plate to the periphery of a ring will decrease the fatigue strength of the material and will increase the breakage tendencies; the amount of face taper of a chrome plated top ring affects oil consumption; the method used to form the OD corner affects oil consumption; the load carrying capacity of chrome plate is not appreciably higher than cast iron but the rate of wear is less; adding chrome plate to piston rings will increase their life when run under dust conditions, but no ring setup tested will permit the engine to digest large quantities of dust.

Alfred Z. Boyajian, Structures Project Engineer, Republic Aviation Corp., discussed "Simplified Structures for Low Cost Airplanes." Fabrication



NOPAK *Reciprotrol Valve*

Provides All Three — in Full Measure!

This radically new, 4-way, automatic reciprocating valve features Built-in Controls which provide the *following advantages* in operating any size or make of air or hydraulic cylinder, at 50 to 300 lb. line pressure:—

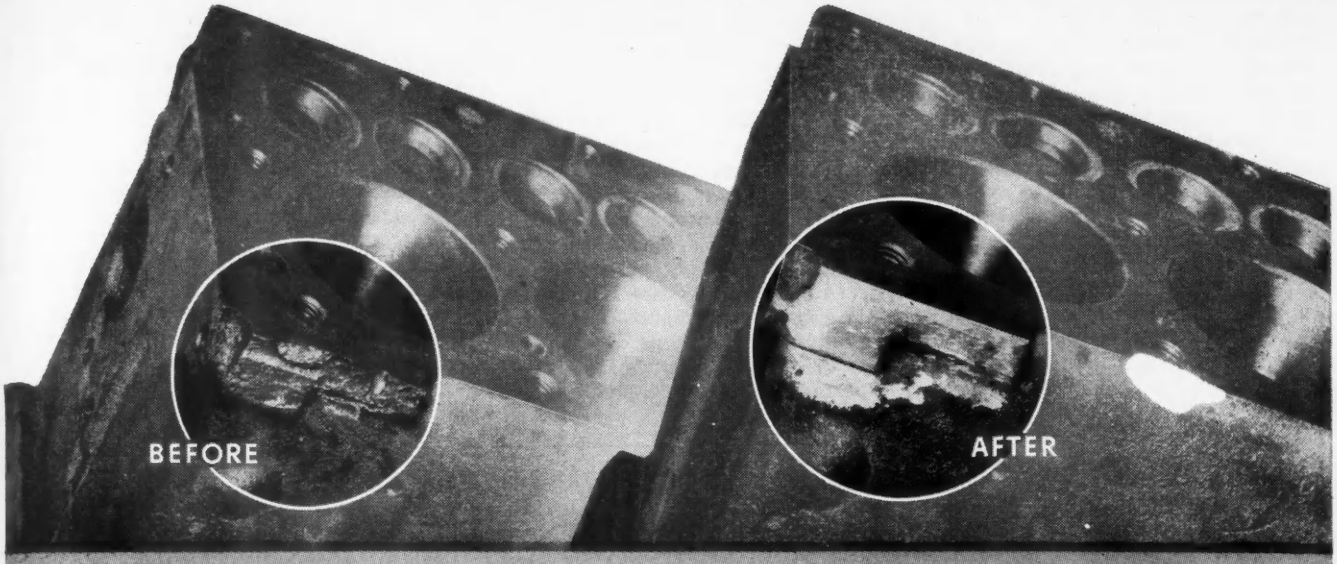
- Built-In Speed Control regulates stroke-speed in both directions, independently; allows choice of cycle speeds from 0 to 500 per minute . . . depending upon cylinder diameter and length.
- Accurate Control of Stroke Length from fractional to full.
- Precise Location of Fractional Stroke anywhere within full stroke length.
- Fully-Automatic, Semi-Automatic or Manual operation.

Write, Today, for More Information on the Amazing Reciprotrol.

GALLAND-HENNING MFG. CO., 774 S. 31st ST., MILWAUKEE 7, WIS.

NOW IN ⅜" PIPE SIZE!
The ⅜" pipe size in which Reciprotrol is built makes it suitable for most oscillating applications.

NOPAK
VALVES AND CYLINDERS
DESIGNED for AIR and HYDRAULIC SERVICE
A 5022-½I-R



NI-ROD REPAIRS CASTINGS Quickly Easily

With smooth-handling Ni-Rod available, you can effectively salvage castings with sound, *crack-free* welds.

These "BEFORE" and "AFTER" pictures show how welding with Ni-Rod cuts costs for a leading automobile manufacturer.

Left photo shows a defective cylinder block. Machining revealed a blowhole right at an important lug section.

Right photo shows the same block after the section had been ground down . . . built up with Ni-Rod . . . finished by grinding.

It is just as sound as a perfect casting.

No preheat was required and finishing was easy. The foundry reported Ni-Rod to be the best welding rod they ever used to repair castings.

You'll find plenty of jobs for Ni-Rod. Deposits are smooth, sound, strong, machinable, and close to the color of cast iron. Ni-Rod is easy to handle; slight variations in manipulation do not affect weld quality. And, you can use Ni-Rod on a.c. or d.c.

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time and manufacturing costs as low as 10 and 20 per cent respectively of those required for conventional designs can result for some all-metal planes by drastic simplification of their basic pattern. The speaker described how these savings were actually achieved in one airplane without resorting to anything new in the way of materials, shop practices or manufacturing facilities. New theories of stress analysis were suggested for transferring normal shear loads in a chordwise direction to the bending resistant spares of a stressed skin wing, and these theories are the key to the radical reductions in time and costs. Boyajian gave a list of design rules common to all low cost structures and urged the airframe designers to exploit these rules.

In a manufacturing sense, the aircraft industry came of age during the war. The benefits of this development constitute a tremendous asset to the industry today, according to Prof. Horace M. Gilbert, California Institute of Technology. In his paper, "Postwar Aircraft Industry Cashes In On Wartime Experience," he pointed out that the manufacturing function, so important during the war, may not be so important now in individual cases. Other functions, especially engineering or, in the case of personal planes, sales, may now be more important than production. The excellence of manufacturing practices that is a heritage from the war constitutes an expensive way of doing business unless production volumes are high or unless management is extraordinarily clever in keeping costs down. Not all companies were equally successful in mastering advance manufacturing practices during the war so that today some are still trying to find answers to elementary questions. The aircraft industry has learned a great deal from wartime experience about manufacturing performance standards so that the jobs of production planning, cost estimating and pricing can be carried on more satisfactorily than before the war. Although marked technical progress took place in the field of aeronautical engineering, wartime experience was disappointing in that little if any progress was made in shortening the elapsed time for engineering development, and the costs of such work became exceedingly high.

In his usual scintillating manner, William B. "Bill" Stout presented a paper, "A New Approach To The Flight Problem." But quite seriously, nevertheless, Stout maintained that we have been approaching the study of flight from the wrong family of animals. We have studied birds, but birds are not very good fliers. However, insects fly successfully and with payloads, with wings of very much smaller proportion than birds, and make higher speeds proportionately. His experimental work, though of very elementary nature, leads him to believe that this fresh approach warrants enthusiastic research. A great deal of study needs to be done with a stroboscopic and high-speed photography, not only on the insects themselves, but on the apparatus that is built up to see what is actually going on, rather than having to guess at it. "With the flapping wing you have the possibility of helicopter take-offs and better than airplane forward speeds. Also, full engine power and flywheel effort can be used for hovering, landings, and vertical descents, after we learn more about what the wing does. The principle is there, and all the rest is accomplished except the engineering," Stout said.

Only through sound planning, advances in mass production methods, development of time saving machinery, and through an overall standardization program can we be assured of our success in any emergency, according to Maj. Gen. E. M. Powers, Asst. Chief of Air Staff, Materiel Division, Washington, D. C. "Production of the United States tipped the scales toward victory in the first two wars. We cannot minimize the importance of industrial preparedness. If we have a sound industrial preparedness program, the United States will be doing its share to insure peace in the world," General Powers stressed.

- Buell Air Horns are tops in warning signal efficiency.
- Installed as original equipment on many Trucks and Buses.
- They reduce maintenance costs by decreasing stops, starts and slowdowns.
- All records prove that they save tires, brakes, clutches and gears.
- Cut gas and oil consumption.

With a Buell the driver has greater security, maintaining a steady cruising speed. Slowing a 20 ton load from 50 MPH to 30 MPH means destroying a lot of energy thru brake lining and tires. It is replaced by burning more gasoline, increasing load on engine, and tires again, to regain speed. This all costs money. We believe a Buell Air Horn is worth $100.00 yearly on any heavy highway vehicle. Then remember a Buell will last more than 10 years. How would you rate a $100.00 investment that earned $100.00 yearly for 10 years. Ask the man who has a Buell.

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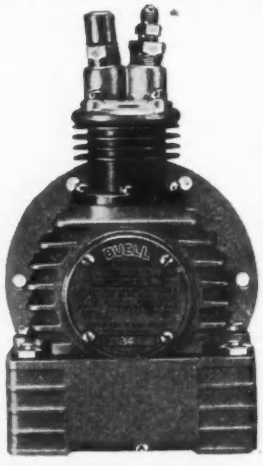
Buell engine-driven compressors supplied air to operate air brakes in thousands of R.C.A.F. aircraft. Only a combination of quality and precision workmanship could meet the requirements of this type of service.

Designed for compactness and light weight, they are far more efficient and powerful than their size indicates. Let us prove their adaptability to your needs.



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2975 Cottage Grove Ave., Chicago 16, Ill.

Mobile Electronometer

(*Continued from page* 31)

120 ohm strain gage is placed in parallel with a fixed resistor having a resistance of 89,690 ohms. The strain gage had an actual resistance of 119.72 ohms. By using Ohm's law of parallel resistance, we find that the resulting resistance is 119.56 ohms. This means that the change in resistance is 0.16 ohms.

The manufacturer of the strain gages provides the following formula for use in calculating stresses:

$$\text{Unit Strain} = \frac{1}{\text{Gage Sensitivity Factor}} \times \frac{\text{Change in Gage Resistance}}{\text{Initial Gage Resistance}}$$

where unit strain is micro-inches per inch.

Sensitivity Factor has no units and is furnished by the manufacturer of the gages.

Gage resistance is ohms.

The Gage Sensitivity Factor is defined to be the ratio of the unit resistance change to the unit strain change. It is not affected by temperature change. Exact values given with all strain gages are guaranteed to one per cent.

Substituting actual values in the above equation, we have:

$$\text{Unit Strain} = \frac{1}{2.06} \times \frac{.16}{119.72}$$

Unit Strain = 649 micro-inches per inch.

Stress then equals 0.000649 × 30,000,000 or 19,500 psi. Because the circuit described above lowers the strain gage resistance, it produces the equivalent of a mechanical stress.

Calculation of stresses for both static and dynamic loading is done in much the same manner. The first step is to determine unit stress against the width of the unit graph. With the calibrating circuit properly adjusted, the zero stress is 15 mm wide and compressive stress is 19,500 psi is 30 mm wide, Fig. 6. Since the difference between 30 and 15 is 15 mm, the stress per mm of chart record will be 19,500 divided by 15 or 1300 psi. In a specific case, if the graph of one of the gages is 20 mm wide and we use the zero reading of 15 mm, the difference is 5 mm and stress is 5 ×1300 or 6500 psi in compression. On the other hand, if the graph of a gage is only 5 mm wide, then the difference is 10 mm and stress equals 13,000 psi, but in this instance it is in tension.

The use of the strain-recorder is by no means limited to stress testing. By using the proper types of pickups this equipment may be used as a vibration indicator, surface analyzer, high speed timing device, etc.

On occasion, the equipment is used to time the speed of application and release of vacuum operated trailer brakes. For this purpose they use a bracket which anchors one end of a strip of spring steel. The other end of this strip is fastened to the pull-rod of the brake operating chamber. A strain gage, glued to the surface of the strip, records the stress due to bending. One gage is used for each brake and all the gages are connected in the customary manner to the switching unit.

The left hand pen of the oscillograph provides a time element for the test. A small, vacuum-operated electric switch is connected into the vacuum system at the brake hand control valve and this in turn is connected in series with a small transformer directly to the amplifier input for the left-hand pen of the oscillograph.

In the actual test, the brake system is evacuated to a predetermined amount and the hand valve turned so as to apply the brakes. Immediately the left-hand pen starts oscillating. As soon as the pull-rod of the brake chambers starts to move, the right-hand pen

(*Turn to page* 68, *please*)

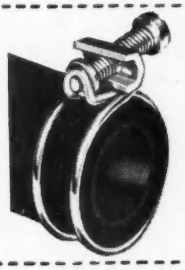
THE CENTRAL 360° IS YOUR

new and improved

WIRE HOSE CLAMP

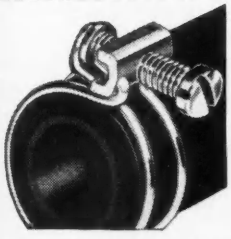
PUSH + PULL POWER! LOOK how the new, perfect mechanical principle of push plus pull clinches this clamp's powerful wire strands into a vise-like grip on the hose. *Every* part is "oversize" for extra strength. Compare the driving power of the 360 powerful screw with that of the ordinary hose clamp.

1



NO BLIND SPOT! THE ABSENCE of a "tongue," found in all other clamps, completely eliminates the "blind," or "soft" spot—the primary cause of leakage in other clamps. Also, the unusual takeup of the 360 guarantees the elimination of leakage trouble—even on today's irregular synthetic hose.

2



A PERFECT CIRCLE! DON'T OVERLOOK how, because of the new push plus pull principle, terrific pressure is exerted on every point, without damage to the hose. This 360 degree grip which maintains the same amazing pressure on the entire circle of the clamp is positive leak prevention.

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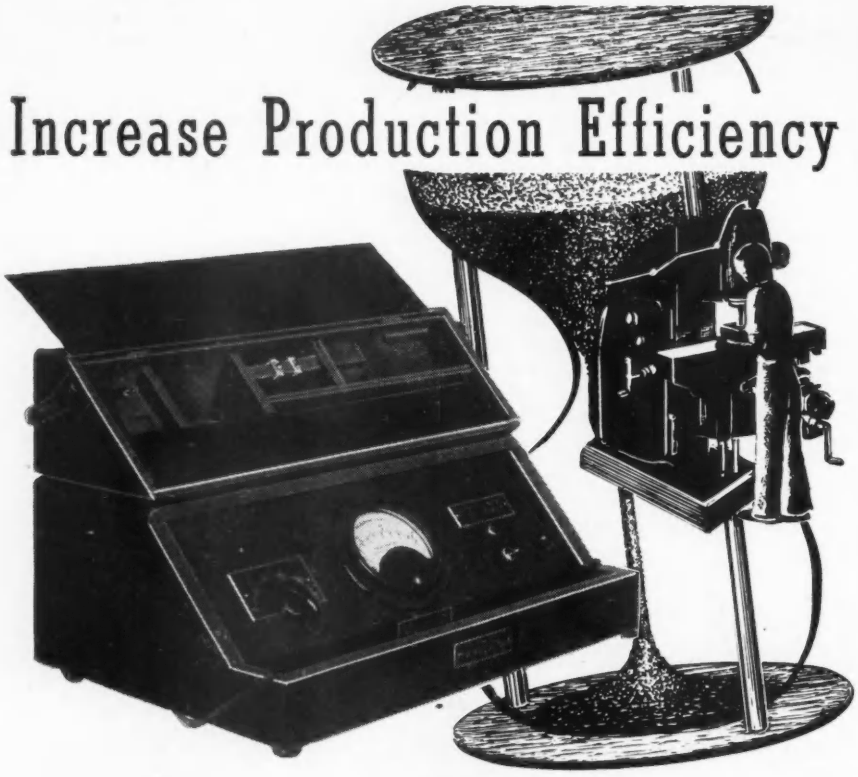


. . . with the Profilometer

Here are a few of the ways in which the Profilometer can increase production efficiency in your plant:

Reduce machining time.
The Profilometer enables you to stop machining as soon as a satisfactory finish has been obtained. The Profilometer also enables control of the finish produced by intermediate operations. The finish left by such operations has a pronounced effect on the speed with which final operations bring a part to size and final finish.

Reduce number of machining operations.
With the Profilometer, the manufacturer can often make *one* machining operation do the work previously requiring two or more operations. Likewise, less expensive or faster machining methods may often be substituted for slower more costly ones, gaining efficiency at no sacrifice of quality.

Produce fewer rejections unacceptable because of poor finish.
With the Profilometer in the shop, production of substandard finishes can be caught as soon as it occurs and remedied before the parts get to final inspection.

Increase control of all machining operations.
The Profilometer aids in the determination of proper feeds and speeds, and in determining the frequency of wheel redressing and tool resharpening.

A demonstration of the Profilometer in your plant will indicate its application to your work. Write us to have our representative call. Catalog on request.

Profilometer is the trademark registered with the U. S. Patent Office indicating Physicists Research Company's brand of surface-roughness measuring equipment.

PHYSICISTS RESEARCH COMPANY
ANN ARBOR, MICHIGAN

makes a record of the stress in the spring steel strip.

An examination of the chart, Fig. 7, will show that the brakes were applying from point B to C and since the pens are oscillating at a 60 cycle rate, it is only a matter of counting the peaks between B and C to get the elapsed time.

Now that we have examined the design and instrumentation of the test unit, let us consider a few of the results that have been accomplished through its use. Fig. 8, shows a static stress analysis study of a Trailmobile side rail and bolster assembly. Initial studies of side rail loading indicated a region of stress concentration as shown at the left, with a sharp peak. Actual failure of the side rail at this point was experienced in road testing. Various means then were tried to reduce stress concentration. The most effective was the use of a simple bent strip which produces a rounded corner at the juncture of the members, as shown. This reduced stress concentration to the value of the lower peak and effectively eliminated failure.

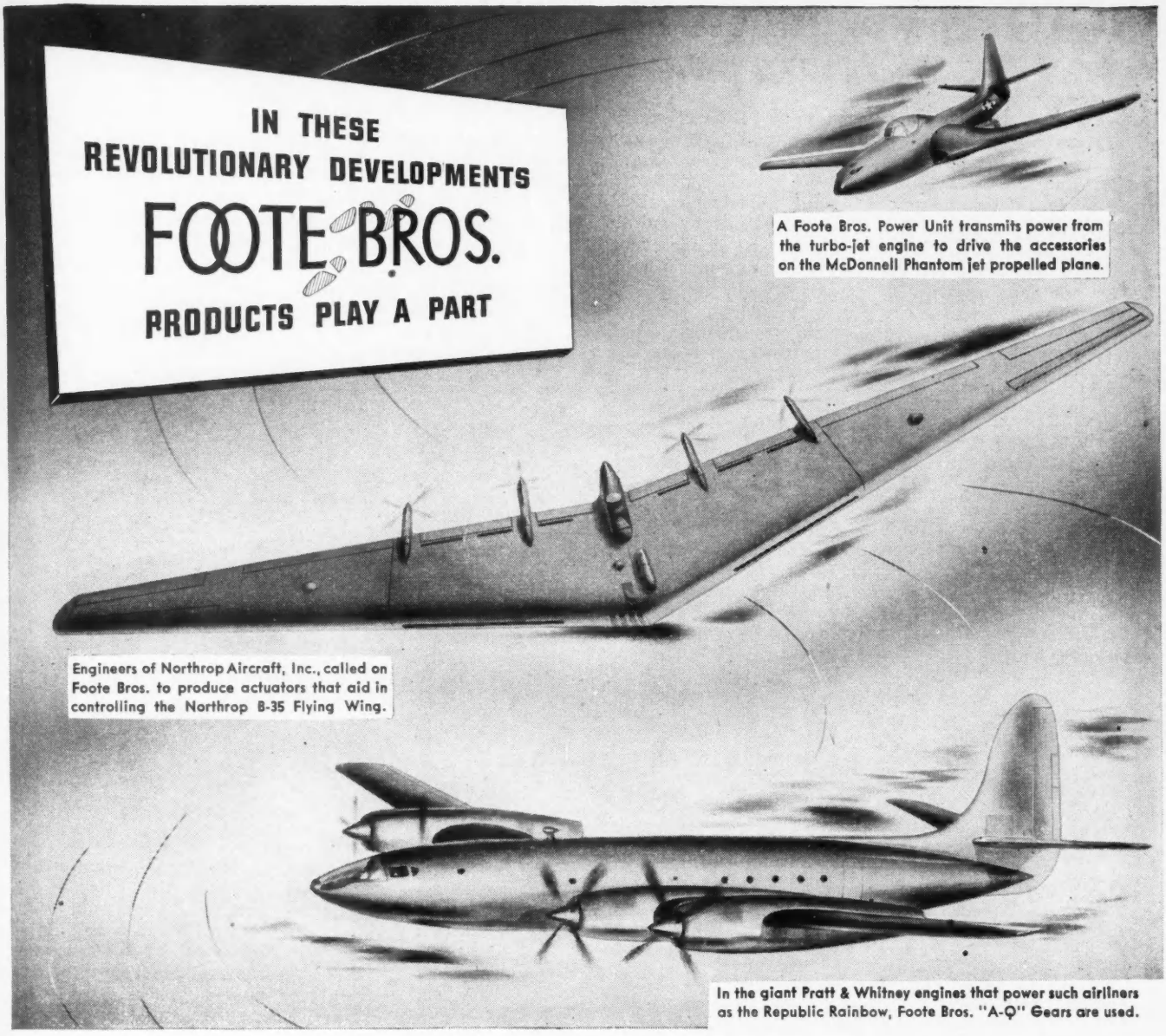
While many other examples can be cited, this one is typical of the test procedure, interpretation and remedial measures.

One of the most important results of this technique is the adoption of the Trailmobile light-weight, light-section under-construction in which the bolsters carry the load while the light frame serves principally as a means of distributing the load equally among the members and to the load-carrying skin.

An equally valuable contribution to strong but light-weight design is the development of the U-shaped channel posts and struts for the side structure. The side framing consists of a honeycomb of diamond-shaped struts and posts. Stress analysis proved conclusively that the channel section carries the stress on the inner member and does not require stiffening on the outside. (In the latter case a closed member would be required.) The diamond-struts are spaced 18 in. apart, providing an enduring structure of minimum weight.

One can readily visualize how the rious, since each strain makes an indeinvestigating the load-carrying ability of brackets and hangers and other heavy parts; how the size and weight of such parts can be reduced to a minimum by means of scientific analysis.

Although the test procedure is laborious, since each strain makes an independent record and since the test cycle must be repeated for each of the 48 gages, the results amply justify the time and effort thus expended. For the scientific method gives assurance of quality and durability while at the same time it offers a definite means of developing a well-balanced design of lowest weight and minimum cost.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PICAO Airworthiness Standards

(*Continued from page* 39)

on the part of the pilot, nor exceptionally favorable conditions;

(d) the gradient of the steady approach, and the details of the technique used in determining the landing distance, shall be entered in the airplane flight manual, together with variations in the technique recommended for landing with the critical engine inoperative, and any appreciable variation in landing distance resulting therefrom.

BRAKE SYSTEMS—If brakes are used to demonstrate compliance with the performance requirements, the brake system shall be so designed and constructed that it shall be possible, as shown by suitable test or other data, (a) in the event of a single failure in any connecting or transmitting element in the brake system, excluding the operating pedal or handle, and simple mechanical elements, or (b) in the event of the loss of any single source of hydraulic or other brake-operating power supply, to bring the airplane to rest under the foregoing conditions prescribed in landing, with a mean negative acceleration, during the ground run, equal to at least 50 per cent of that obtained during the determination of the landing distance, as prescribed in that paragraph. In determining the mean negative acceleration in such cases, account may be taken of remaining effective braking forces and aerodynamic drag, including that due to reversible-pitch propellers or other special devices which have been demonstrated in the performance tests.

Design and Construction of Exits

NORMAL EXITS—Airplanes having closed cabins shall be provided with at least one normal exit in the form of an adequate, easily accessible main door. It shall be possible to open normal exits from both inside and outside, but a single handle only shall be required in each case. The operation of the handle shall be simple, rapid and obvious, and the handle shall be so arranged and marked that it can be readily located and operated, even in darkness. Reasonable provisions shall be made to prevent the jamming of doors as a result of fuselage deformation in a minor crash. It is recommended that main doors open outward to minimize jamming by occupants under panic conditions.

EMERGENCY EXITS — All airplanes shall have suitable exits for the purpose of facilitating the rapid escape of all occupants in the event of an emergency landing. To this end, emergency exits of the number and minimum size prescribed in the following paragraphs shall be provided; alternatively, the number and size of exits shall be such as to provide an equivalent standard of safety. (For example, a smaller number of larger exits may be acceptable.)

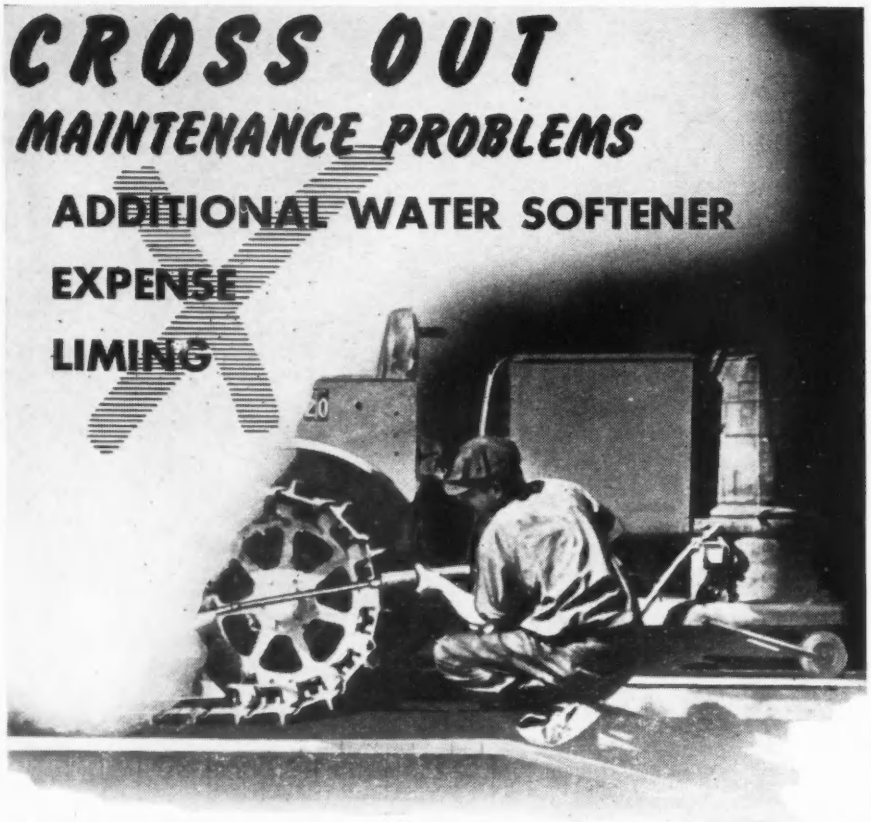
NUMBER—Normal exits may be counted as emergency exits if they meet the detailed requirements prescribed for emergency exits.

Number of seats provided for passenger and crew	Minimum No. of exits required
5 or less	1
Exceeding 5, not exceeding 15	2
Exceeding 15, not exceeding 22	3
Exceeding 22, not exceeding 29	4
Exceeding 29, not exceeding 36	5

In the case of airplanes having more than 36 seats, the number and size of exits shall provide a standard of safety equivalent to that prescribed in the table.

Where the adequacy of emergency exits is in doubt, a demonstration is recommended to show that it is possible to evacuate the airplane completely in 30 sec, or in a time equal to 1 sec per occupant, whichever is greater, under

(*Turn to page* 74, *please*)



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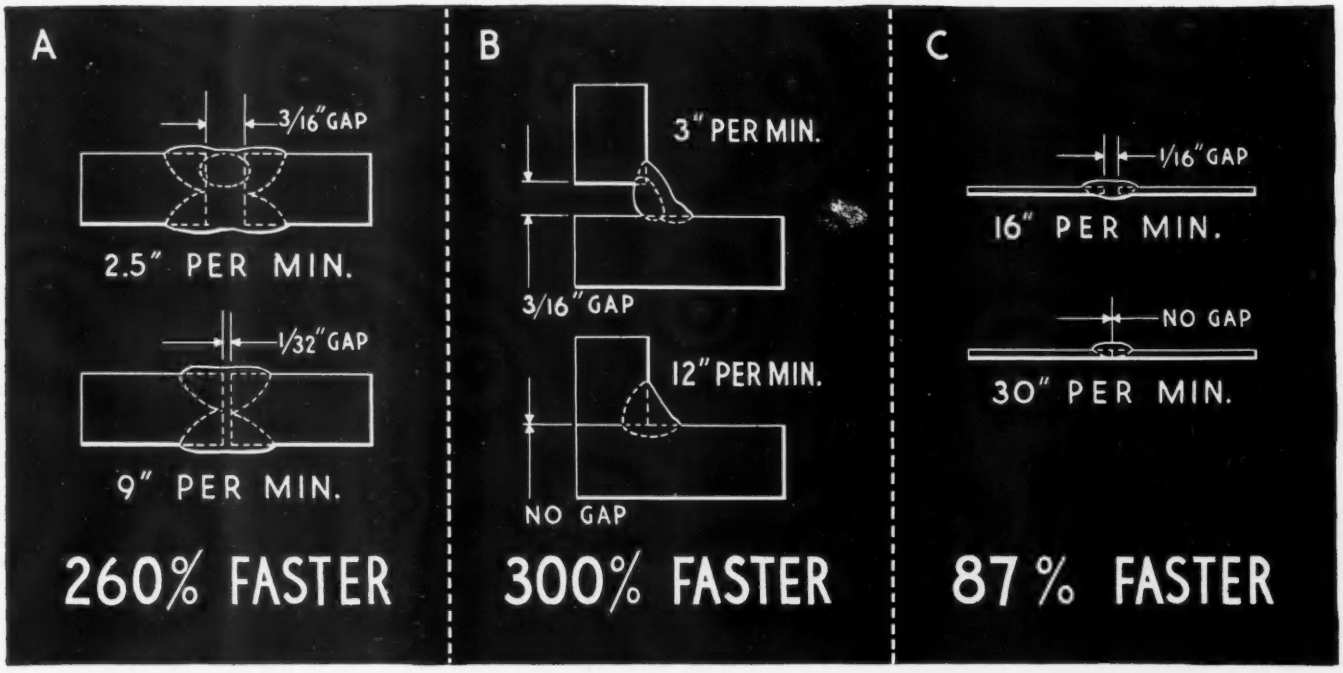
MR. STRACHEY: **Here's food for thought to help you get the full measure of competitive advantage from arc welding:**

GET GOOD FIT-UP



Care in cutting, forming and fitting up of plates and shapes to be welded pays big dividends. By improving fit-up of joints, you increase welding speed and thereby cut costs and minimize distortion.

EXAMPLE A—This square butt joint in ⅜″ plate with gap of 3/16″ is made at an arc speed of 2.5″ per min. With recommended gap of 1/32″, speed is 9″ per min . . . . 260% faster.

EXAMPLE B—This fillet weld in ½″ plate, with 3/16″ gap, is made at an arc speed of 3″ per min. With no gap, speed is 12″ per min. . . . 300% faster. Both welds have a 5/16″ throat.

EXAMPLE C—This butt joint in 14 ga. sheet, with 1/16″ gap, is made at an arc speed of 16″ per min. With no gap, speed is 30″ per min. . . . 87% faster.

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ARC WELDING

conditions simulating an emergency landing. The number of persons participating in this demonstration should be equal to the maximum number for whom seats are provided. The persons participating may be briefed in evacuation procedure.

SIZE—Emergency exits shall consist of easily movable doors, panels or windows, in the external walls of the cabin, providing a clear and unobstructed opening, the minimum dimensions of which will enable a 19 in. by 26 in. ellipse to be inscribed therein.

LOCATION—The exits shall be so located as to enable them to be used to the best advantage: (a) after a minor crash, such as may occur in an emergency landing; this shall apply to all airplanes; (b) after ditching; this shall apply to all airplanes complying with the following requirements of ditching.

It shall be shown that:

(a) The design of the airplane is such that, as far as is practicable, its behavior in a premeditated ditching will be unlikely to cause immediate injury to the passengers, or to make their escape impossible; (b) the airplane would, after such ditching, remain afloat for a period long enough to permit all the occupants to leave their normal stations and escape from the airplane.

The following procedures for demonstrating compliance with the ditching requirements are acceptable: The probable behavior of the airplane should be investigated by model tests or by comparison with airplanes of similar configuration, for which the ditching characteristics are known. In making such tests or comparisons, proper consideration should be given to scoops, wings, wing flaps, projections and all other factors likely to affect the hydrodynamic characteristics of the airplane under consideration. External doors and windows should be designed to withstand the probable maximum local pressures, unless the effects of the collapse of such parts are taken into account in the model tests or airplane comparison.

Compliance with flotation requirements may be demonstrated by buoyancy and trim computations, in which suitable allowances are made for probable leakage and structural damage. For airplanes equipped with a fuel-jettisoning system, the volume of the space occupied by the jettisoned fuel may be considered as buoyancy volume.

When the flight crew is in a separate compartment, a convenient exit shall be provided for their use. When several exits are provided in the passenger cabin, they shall be distributed to facilitate escape from both sides of the cabin. When the cabin is divided into two or more compartments, each compartment shall be provided with exits, unless the passageways connecting compartments are such that they would not become blocked, or retard passenger movement, in the event of a minor crash. The exits shall be readily accessible and shall not require exceptional agility on the part of persons using them.

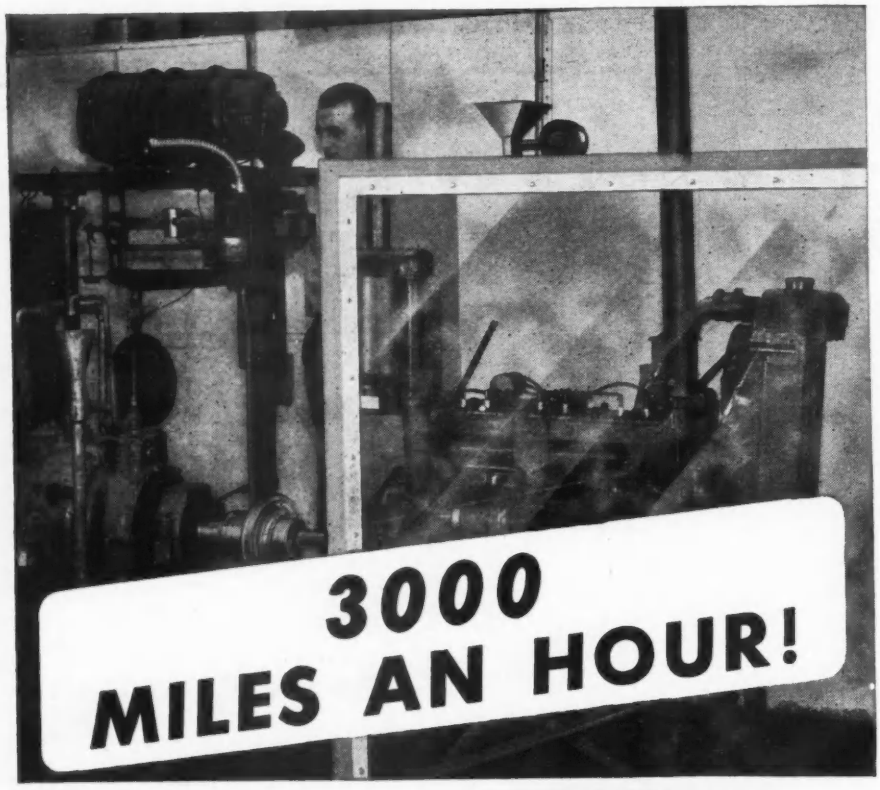
MEANS OF OPENING—The means of opening emergency exits shall be simple, rapid and obvious. All exits shall be openable from the inside, and, when more than one exit is provided, at least one exit on each side of the cabin shall be openable from the outside. Reasonable provisions shall be made against the jamming of exits as a result of fuselage deformation in a minor crash. The proper functioning of exits shall be demonstrated by test.

MARKING—All emergency exits, together with their means of access and means of opening, shall be adequately marked for the guidance of occupants using the exits in light and in darkness.

New Buick Parts Warehouse

Conversion of a wartime tank arsenal into a parts warehouse and shipping depot to expedite flow of spare parts to Buick dealers and owners was announced by the Buick Motor Division of General Motors.

The new parts warehouse, facing Dixie highway at Grand Blanc, Mich., is a 1200-ft-long, one-story structure with 500,000 sq. ft. of floor space.



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2. **Engine operates in dust cloud—clean air fed to induction system to check engine for possible dust leaks.**
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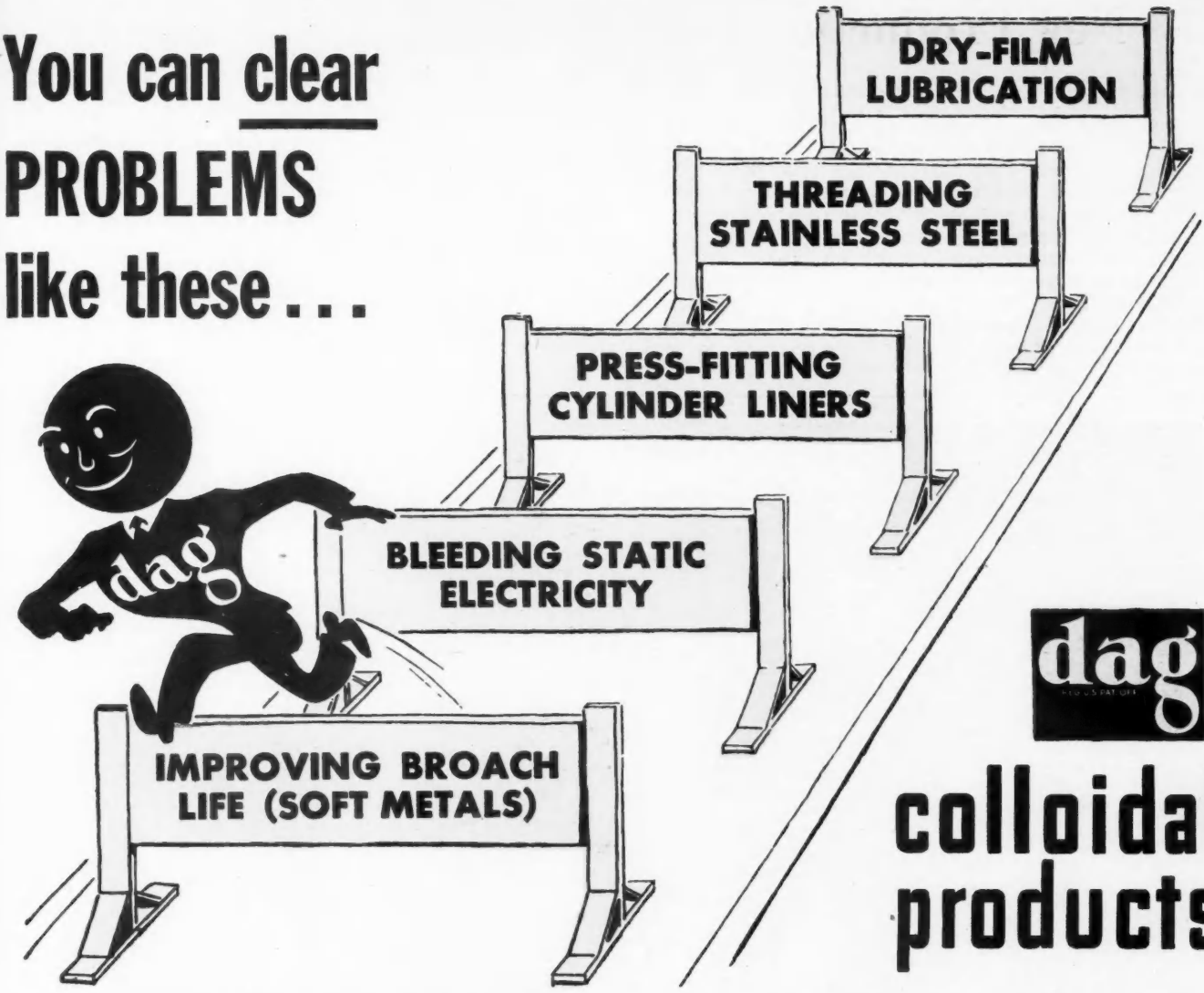

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Please send me without obligation, a copy of each of the bulletins checked:

NAME_____

POSITION_____

FIRM_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

OUR PRESENT OIL SUPPLIER IS_____

(Lubricants containing **"dag"** colloidal graphite are available from major oil companies.)

New Production Equipment

(*Continued from page* 46)

able at extra cost. All operating controls are located at the front of the machine within easy reach of the operator, table and cross-slide hand and power feed controls and electrical push button station are mounted on the front of the bed, vertical feed handwheels and speed change controls are located on the front of the spindle carrier unit.

Power vertical feed to the spindle carrier is available at extra cost. The feed rates, ranging from ¼ in. to 3¾ in. per minute, are infinitely variable. A rapid traverse of 20 in. per minute is provided.

When supplied for die-sinking work, the machine is equipped with the hydraulic automatic depth control, a sensitive hydraulic tracer mechanism which automatically synchronizes the vertical movements of the spindle carrier with either table or cross-slide feed movements to reproduce on the workpiece, the contour of the master shapes or templates.

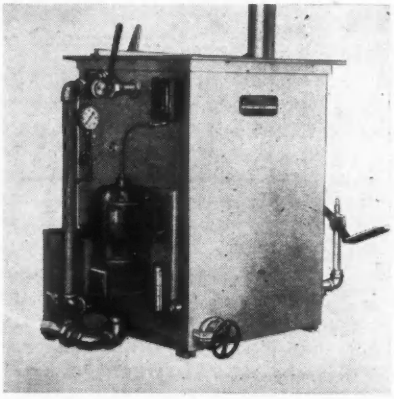
A supporting bracket is provided for use with master shapes, and template support brackets are supplied to facilitate the mounting of sheet steel templates for shapes which remain constant along one axis.

An automatic feed cycle of the cross-slide, with automatic pickfeed of the table at each reversal, is available at extra cost, and, in effect, makes the machine a completely automatic die-sinker capable of producing the entire impression without attention.

STERLING-
Specialists in Aluminum Permanent Mold Castings
Sterling's modern foundry, patented molding process, quality materials, and expert workmanship have been, for years, producing the finest in aluminum pistons.
This same expert workmanship and patented molding process has enabled us to develop many special permanent mold aluminum castings for the automotive and aviation industries.
Wherever a minimum of finishing and light weight is a factor, our engineers' experience will be of value to you in developing a permanent mold aluminum casting to economically meet your requirements. Call or write
STERLING ALUMINUM PRODUCTS INC.
St. Louis 6, Missouri

A NEW, spray-type washing machine, for the quick and thorough washing of parts on racks, is a recent development of the Optimus Equipment Co., 269 Church St., Matawan, N. J.

This new Optimus machine can be placed directly on the floor—no pit or cement work is necessary. The top of the unit is at working height, and all connections are readily accessible. Spray nozzles are adjustable and replaceable.



Optimus spray-type washing machine

The same machine can be used with submerged agitation to remove caked greases, such as Tripoli compound and abrasives.

This machine is designed to eliminate hand-cleaning of small metal parts. It can be used individually, or in series where the washing operation requires several steps, for example, solvent wash, rinse, alkali wash, second rinse, all of which operations can be done with this type washing machine.

WATSON-STILLMAN CO., 109 Aldine Rd., Roselle, N. J., has added three new presses to its line.

The semi-automatic 200-ton capacity compression molding press is of four-column construction, with all vital controls easily convenient. All internal pressure seals are made with metal piston rings. External packings are of the "V" type, readily accessible under glands. External stuffing boxes are equipped with bronze throat bushings. Moving platens have integral, barrel-type guides for the columns—fitted

(*Turn to page* 78, *please*)

ENGINEERED for efficient motor temperature

LONG

CLUTCHES • RADIATORS • OIL COOLERS

Long radiators are designed for the individual cooling requirements of the engines they serve. Capacity, area, number and placement of fins and tubes, cooling characteristics are precisely engineered to maintain engine temperatures of highest operating efficiency . . . 43 years of experience back up every Long radiator for car, truck, bus, and farm machine. LONG MANUFACTURING DIVISION, Borg-Warner Corp., Detroit 12 and Windsor.

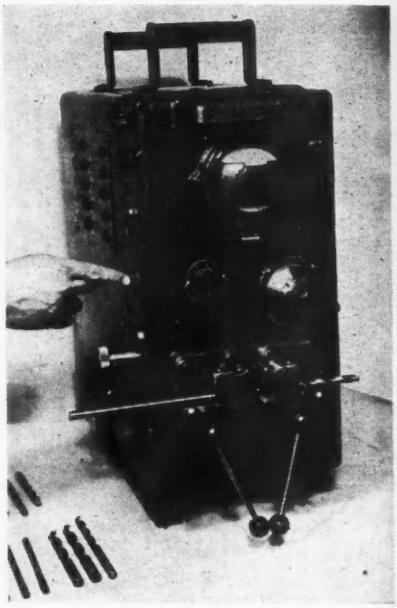
with split bronze bushings and Alemite fittings for lubrication.

The Watson-Stillman 150-ton heating press features a stop valve which locks pressure in and holds it there for long periods. This characteristic of pressure retention is said to increase the value of this press in many types of plastic hot pressing and laminating.

Among other features which add to its suitability for many kinds of plastic heating operations is a separate radial piston constant displacement pump with integral low-pressure gear pump that can be placed in convenient proximity to press.

The 75-ton hydraulic press incorporates several advances in machinery design which make it well fitted to handle many kinds of light embossing, laminating and similar work. The 4-way valve, located within easy reach of the operator, affords complete manual control of the press at all times. Large platen area and comparatively low pressure also aid the machine in achieving its purpose of light pressing. Pump is a separate unit, of radial piston constant displacement type with integral low pressure gear pump.

DESIGNED for production welding of bar and round stock up to 5/16 in. diameter, a new portable welder is

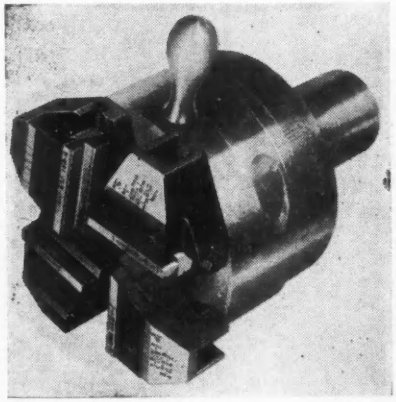


DBW-3A DoALL welder

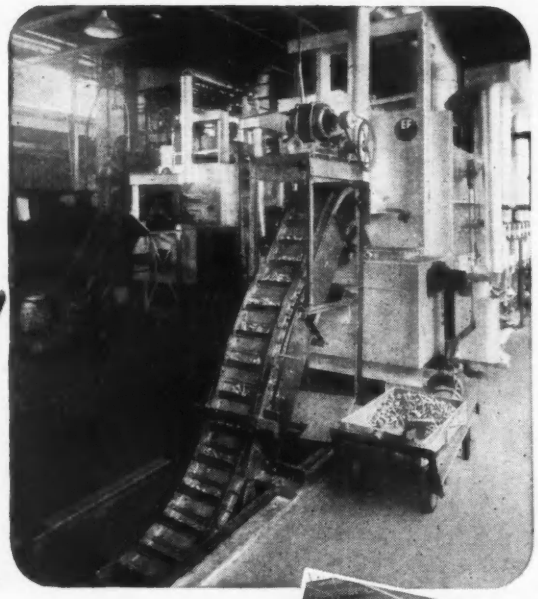
now in production at the DoALL Co., 1301 Washington Ave. South, Minneapolis 4, Minn. It is said to be particularly adapted to uses such as repairing small tools, butt welding tool bit extensions and shanks and joining band saw blades from 1/16 in. to 1¼ in. in width. Features include: Built-in grinder for weld dressing; automatic motor controlled feed of material, and cam operated lever method of clamping which speeds up the welding operation. Welding is fully automatic, the complete cycle being controlled by a single pushbutton switch. In addition to welding, annealing and flash dressing, an etching attachment provides a means of permanently identifying tools, templates, attachments, jigs, fixtures, dies, etc. Designed for standard a-c 220 volts single-phase 50/60 cycle operation, this model DBW-3A, either pedestal type or in a metal carrying case, can be supplied for other voltage requirements.

THE LANDIS MACHINE CO., Waynesboro, Penna., recently placed on the market a double-diameter, tan-

(*Turn to page 82, please*)



Landis double-diameter thread chaser

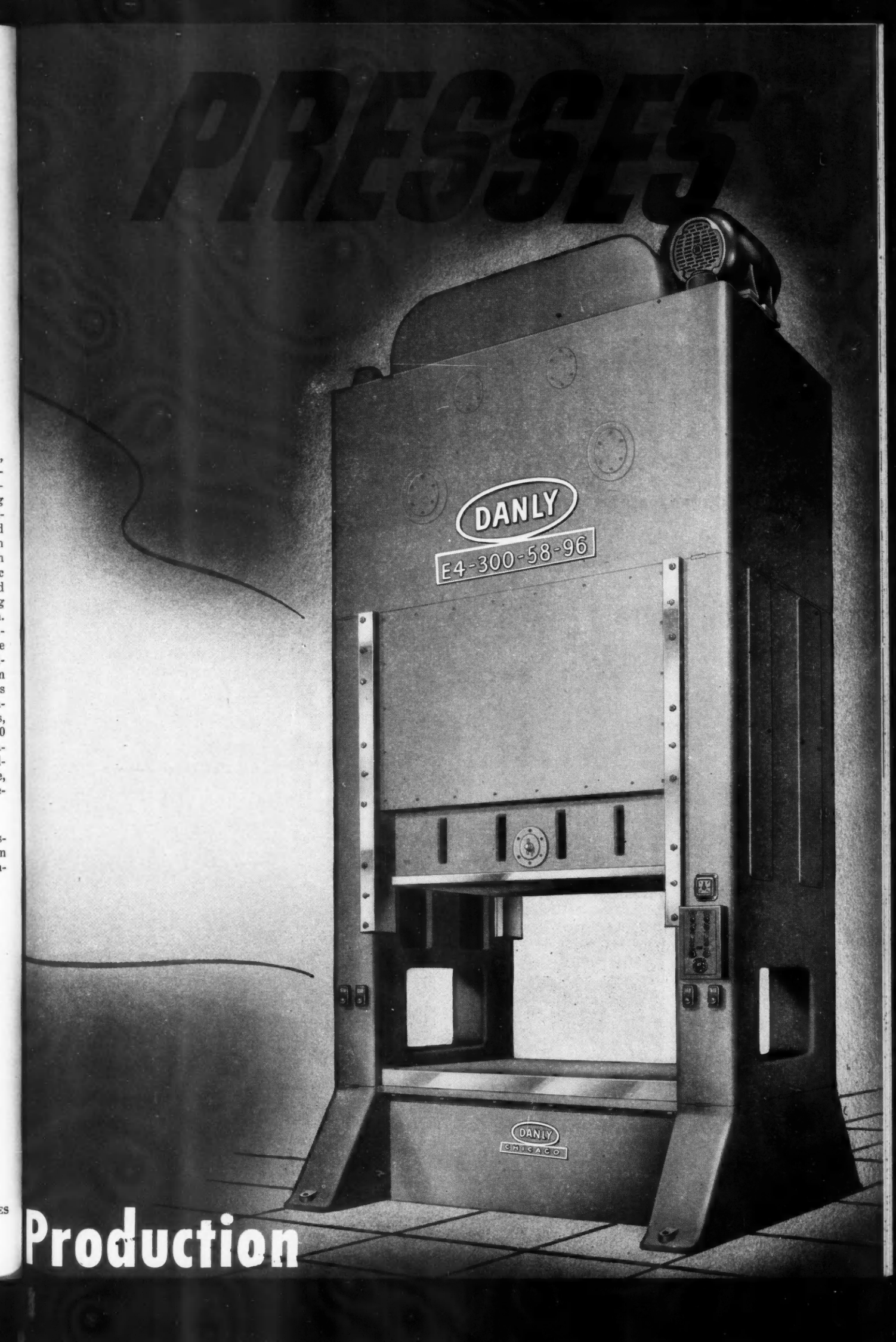


SCALE FREE • LOW COST • CONTINUOUS • hardening of small parts

EF CONTINUOUS CHAIN BELT CONVEYOR TYPE FURNACES are furnished in gas fired, oil fired and electric designs, in 11 standard sizes ranging from 175 lbs. to 2000 lbs. capacity per hour. The material to be processed is loaded onto the cast link heat resisting conveyor belt, carried into the furnace automatically, heated uniformly and accurately to the desired temperature, quenched and discharged. The furnaces are readily adapted to use with special protective atmospheres for heat treating and hardening without scaling or decarburization.

Performance records of hundreds of installations prove that these furnaces are unsurpassed for the efficient economical heat treatment of a wide range of small and medium size parts. But send for our 12 page Bulletin No. R-1 —"Chain Belt Conveyor Furnaces"— it gives full details — and let EF engineers work with you on your next heat treating job!

THE ELECTRIC FURNACE CO.
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION
Salem-Ohio


PRESSES
DANLY
E4-300-58-96
DANLY
CHICAGO
Production

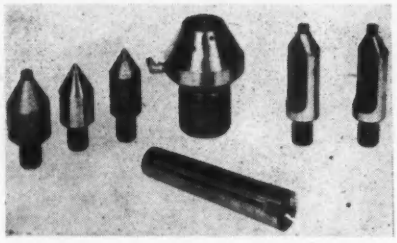
gential-type, ground thread chaser.

The chasers have all surfaces and the thread form ground after hardening and hold within a class three fit on the two diameters.

It is essential that the threads produced on the two diameters be of the same form and pitch.

There are limitations in the difference between the two diameters for which the chasers can be furnished, and each set of chasers must be engineered for the threading job on which it will be used.

Both diameters of threads on the work piece should be of a fairly short length to satisfactorily use the double-diameter chaser.



Machine centers made by Black Drill Co.

BLACK DRILL CO., Division of Black Industries, Inc., 5005 Euclid Ave., Cleveland, Ohio, is now manufacturing a new line of machine centers.

This machine center set as sold consists of a single shank and an assortment of six noses which thread into the shaft. Once the shank is placed in the spindle of the head or tail stock, it never needs to be removed — simply change noses to suit the requirements of the work. Noses are made of high-speed steel, heat treated to 65 Rockwell.

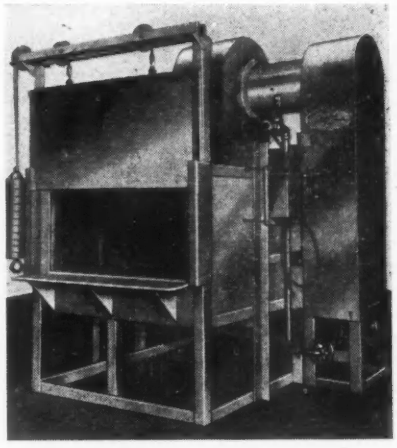
Centers are made in a complete range of sizes (No. 2 to No. 12) for lathes and grinders, with Morse, Brown and Sharpe, and Jarno tapers and with straight shanks for screw machines.

VAPOFIER CORP., 10316 Throop St., Chicago 43, Ill., is introducing an improved Vapofier. The Vapofier, utilizing fuel oil, generates and supplies a vapor (vap-o-gas), which is then mixed with air and is piped, burned and controlled in exactly the same manner as utility gas.

Fuel oil is maintained at a constant level in the combustion chamber by a float valve. The products of combustion are drawn through the surface of the oil in the combustion chamber, heating the oil to vaporizing temperature. The vapor thus created is drawn off through the pre-mixer where proper fuel-air ratio is established and maintained. The combustible mixture is then piped to the burners. Fuel-air ration may be predetermined and maintained throughout the entire range of capacity. Flame quality may be widely varied from oxidizing to reducing.

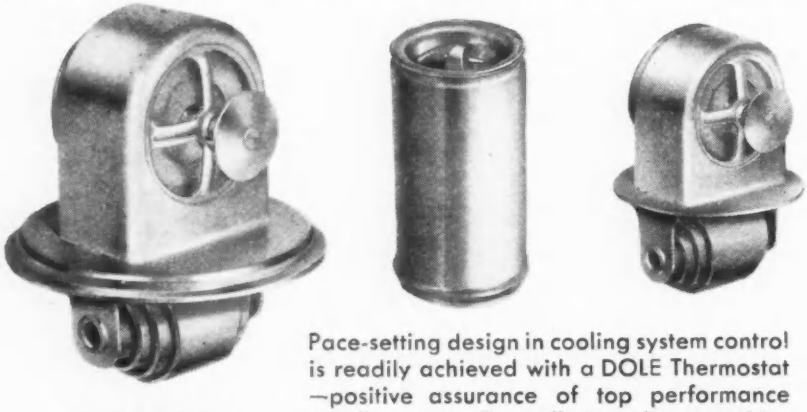
(*Turn to page* 84, *please*)

Furnace for Heat Treating Aluminum Alloys

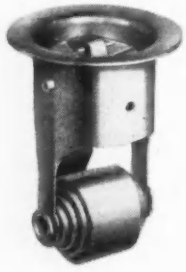


This Bellevue batch type furnace for the heat treating of aluminum alloys consists of an atmospheric-type burner mounted on the lower end of the duct which is used for recirculating the air back into the furnace. A Garden City high-temperature fan is standard equipment for recirculating the heated air. This method of heating is said to hold temperature with little or no variation. Mounting the burner in the duct eliminates the necessity of an extra heating unit. The furnace is made by Bellevue Industrial Furnace Co., 2917 Bellevue, Detroit, Mich.

Tomorrow's
CAR PERFORMANCE
(aided by motor temperature control)
starts on today's drawing boards



Pace-setting design in cooling system control is readily achieved with a DOLE Thermostat —positive assurance of top performance *at all seasons*. Controlled cooling provides quicker warm-up and saves gas, oil and motor wear.



DOLE
Thermostats
in a range of types for every need
THE DOLE VALVE COMPANY
1901-1941 Carroll Avenue, Chicago 12, Illinois
Los Angeles Detroit Philadelphia

Michigan WELDED STEEL TUBING

ALSO
SQUARE • RECTANGULAR
Minimum dimension ½"
Maximum dimension 2¾"
14 to 20 gauge.

ROUND ¼" to 4" O.D.
9 to 22 gauge

IN SIZES AND SHAPES WITHIN THE ABOVE RANGE FOR YOUR PARTICULAR FABRICATING NEEDS!

More than 25 years in the business has acquainted us thoroughly with the needs of manufacturers of parts made from welded steel tubing. Not only is Michigan tubing available in the most frequently specified size range but its structure and manufacture is closely guarded for satisfactory and economical reforming and machining into parts.

PARTS PREFABRICATED

Michigan is completely equipped to fabricate your parts for you. Michigan welded steel tubing can be forged, flanged, expanded, bent, spun, tapered, beaded, machined, etc.

Engineering advice and technical help in the selection of tubing best suited to your needs.

Michigan STEEL TUBE PRODUCTS CO.

More Than 25 Years in the Business

9450 BUFFALO STREET • DETROIT 12, MICHIGAN

FACTORIES: DETROIT, MICHIGAN • SHELBY, OHIO

DISTRIBUTORS: Steel Sales Corp., Detroit, Chicago, St. Louis, Milwaukee and Minneapolis—Miller Steel Co., Inc., Hillside, N. J.—C. L. Hyland, Dayton, Ohio—Dirks & Company, Portland, Oregon—James J. Shannon, Milton, Mass.—Service Steel Co., Los Angeles, Calif.—American Tubular & Steel Products Co., Pittsburgh, Pa.—Strong, Carlisle & Hammond Co., Cleveland, Ohio—C. A. Russell, Inc., Houston, Texas—Drummond, McCall & Co., Ltd., Toronto, Canada.

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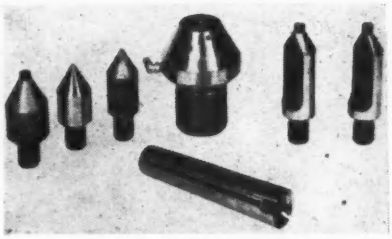

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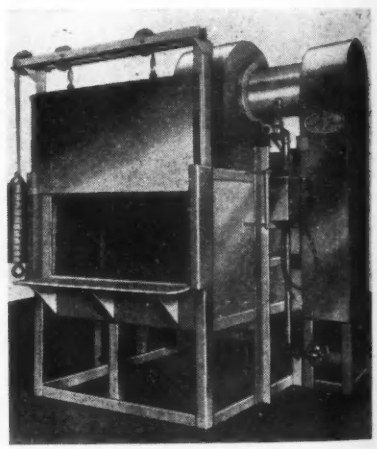

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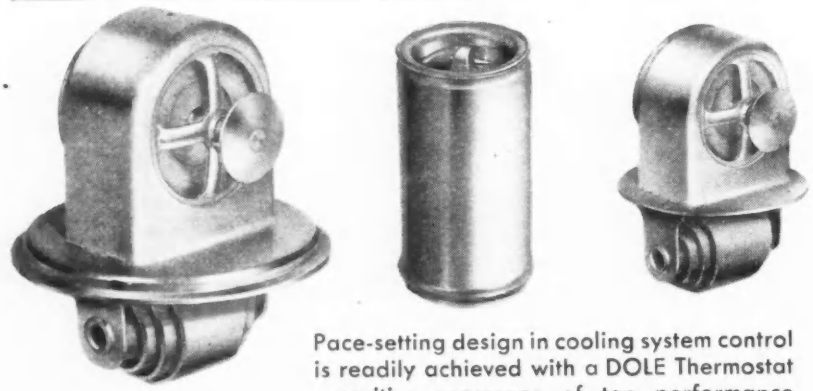

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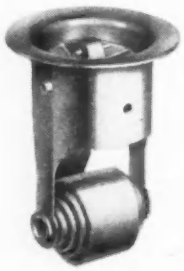

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New... FASTER

FIRE STOPPING POWER

WITH

THE MASTER OF FLAME
ANSUL
REG. U.S. PAT. OFF.
FIRE EXTINGUISHING EQUIPMENT
duGas

DRY CHEMICAL
FIRE EXTINGUISHERS

Greatly increased fire-killing capacity.

Simplified operation.

Expert performance by inexperienced operators.

Quick, easier on-the-spot recharge after use.

More fire stopping power pound for pound, dollar for dollar.

Greater heat-shielding protection for operator.

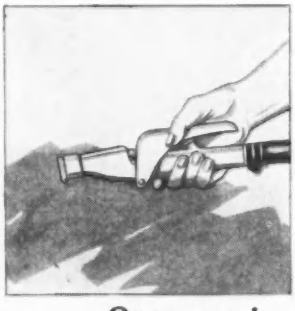
Increased fire-fighting capacity without increased weight.

Engineered to resist corrosion.

Install the NEW Ansul-Dugas Extinguishers at all hazard spots for greater protection against all fires involving flammable liquids, gases and electrical equipment.

Ready...in a Flash!

- Simply remove ringpin and push lever down.



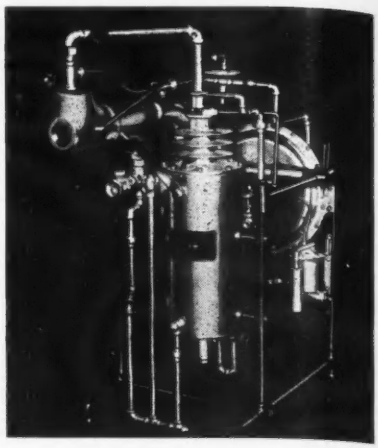
- Open nozzle and direct chemical stream at base of flames.

53% More...
FIRE STOPPING POWER
with the NEW FASTER ACTING
ANSUL-DUGAS
FIRE EXTINGUISHERS

Write today for new catalog and authoritative data showing characteristics of all types of approved hand fire extinguishers.

Listed and Approved by Underwriters' Laboratories and Factory Mutual Laboratories.

ANSUL CHEMICAL COMPANY
FIRE EXTINGUISHER DIVISION • MARINETTE, WIS.



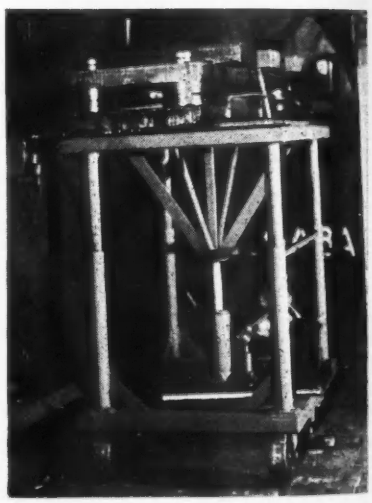
The Vapofier

The Vapofier is an efficient utility gas pre-mixer. By closing a valve to the combustion chamber, the utility gas is mixed with air in proper ratio. In the event of gas cut off or failure, the Vapofier using fuel oil may be cut in without loss of flame at the burners.

The pre-mixer is fully automatic and instantly adjusts to any variation in requirement without change in flame quality. The Vapofier is subject to the same automatic controlling instruments which are used with any gaseous fuel.

(*Turn to page* 86, *please*)

Hydraulically-Operated Die Set Table



Designated as Model No. 11067, this table is product of the Rack Engineering Co., 5102 Butler St., Pittsburgh 1, Pa. The table, rated at 2000 lb capacity, is mounted on heavy-duty roller-bearing casters of six in. diameter with a swivel arrangement permitting easy maneuvering when carrying a capacity load. The load is hydraulically raised by foot pedal to the exact height required for transference of the die set to the press bed against which the table has been placed. A heavy-duty, foot-operated floor lock anchors the table to the job and insures stability while the table is in operation.

What's a two-dollar word for "staying put"?

CARNEGIE LIBRARY OF ATLANTA

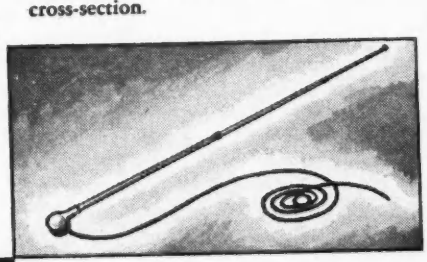
"DIMENSIONAL STABILITY" is the engineer's term. But no matter how you say it, VINYLITE Brand Plastic rigid sheet "stays put" in airplane enclosures . . . through wide temperature and humidity ranges, despite the impact of a screaming airstream, even under the hammer-blows of insects, small birds or hailstones met in midair.

VINYLITE rigid sheet accepts brutal punishment in such uses . . . without fatigue, without distortion. It "stays put," too, in radio dials and crystals, navigation instruments, calculators and other applications where dimensional stability is paramount. And yet it is easy to work—requires shorter dwell in forming operations—shortens the cycle of manufacture—takes any color—or can be "polished" like glass—and is non-flammable.

Search your own processes and materials for a new use of VINYLITE Plastic rigid sheet! You will be rewarded. This versatile plastic pays its way many times over . . . in performance, in appearance and in ease of manufacture.

LONG LIVE UPHOLSTERY! . . . when it's made of cloth coated with a VINYLITE resin compound. Such cloths are waterproof—fade-resistant beyond compare—and they come in all colors of the rainbow. Many textures are available . . . offering extreme flex resistance, abrasion resistance, *long life!*

FOR ANTENNA LEAD-INS and other wires that receive harsh treatment in exposed locations . . . in aircraft or automotive uses . . . investigate cable insulated with BAKELITE Polyethylene and jacketed in tough, resilient VINYLITE Plastic. Great insulation value is gained at much smaller cross-section.



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VINYLITE

TRADE-MARK

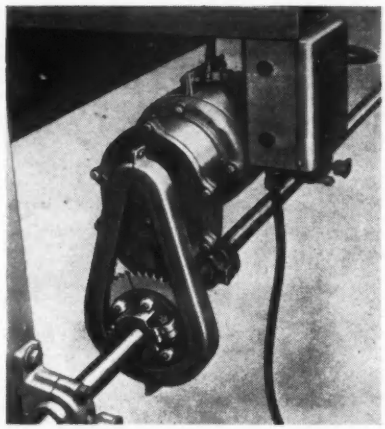
PLASTICS

BAKELITE CORPORATION

Unit of Union Carbide and Carbon Corporation UCC 30 East 42nd Street, New York 17, N.Y.

THE NORTHERN TRAVELATOR, which provides electric power travel for hand traveled overhead cranes, is now available at Northern Engineering Wks., 2615 Atwater St., Detroit 7, Mich., in a universal mounting which makes it applicable to any type overhead crane, both single and double girder. Nearly every arrangement of beam and hoist to be found in hand-traveled cranes can be handled with this new universal mounting.

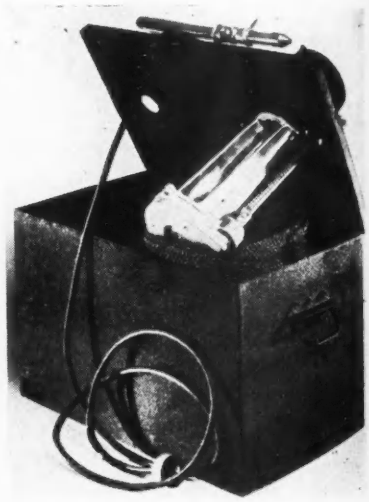
The motor is held in a steel mounting band which is connected to the mounting bracket. This mounting band may be given any position about the periphery of the motor. As a result, the motor may be given any desired position about the axis of the squaring shaft, which it drives. The variety of positions thus made available permit application to nearly all types of hoist cranes.



Northern Travelator

INJECT-A-FLOW PUMP CO., 67 N. Willow St., Montclair, N. J., offers a self-contained filtering system designed to remove particles from liquid coolants used on machine tools.

The manufacturer states that this system can be adapted to the requirements of any machine tool, including grinders. It is claimed that the strainer medium can be made to exclude extremely fine particles without creating back pressure that would reduce the flow of coolant to the cutting tools.

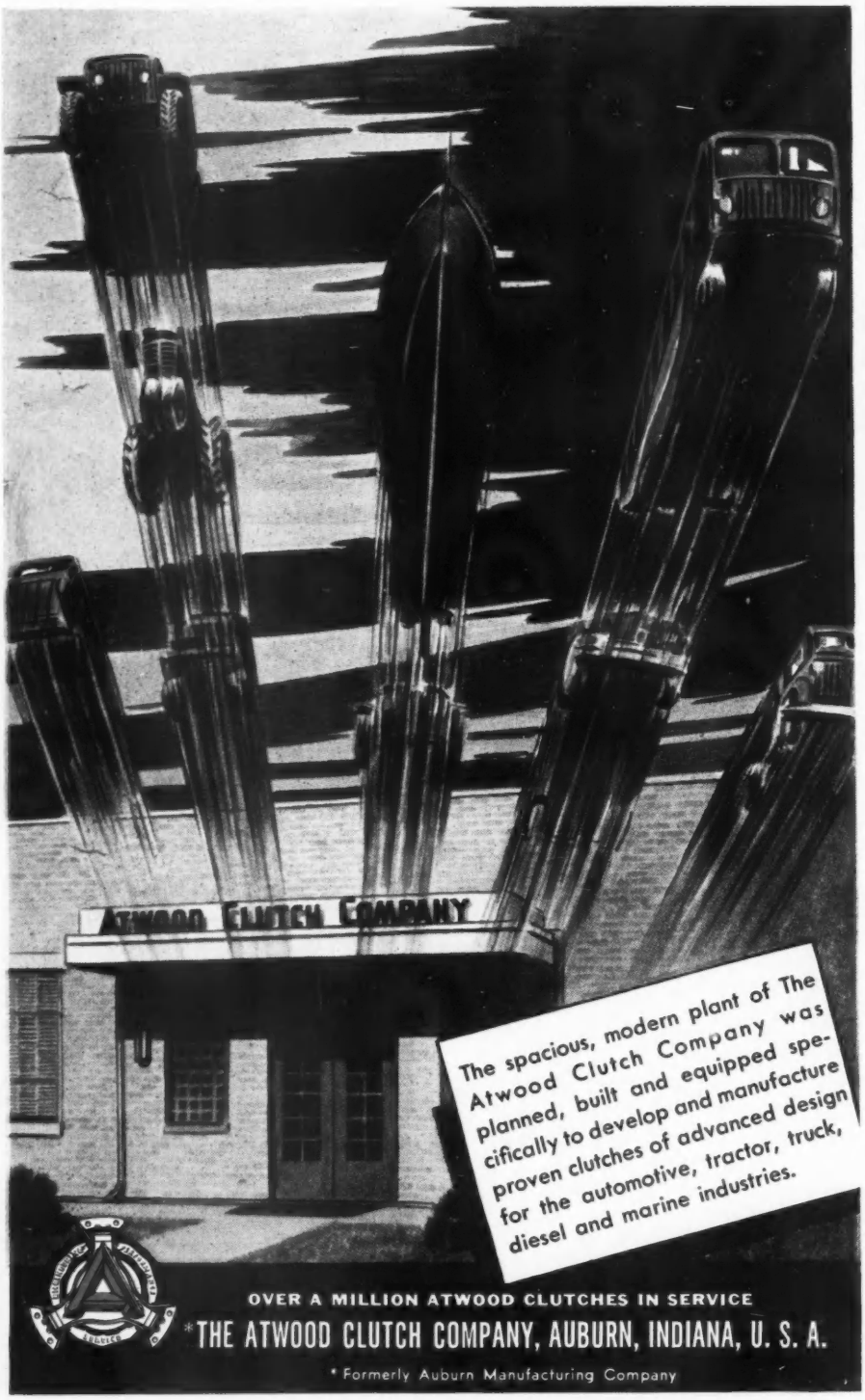


Inject-A-Flow filtering system

The system consists of a 7 gal rectangular steel tank in which a Strainco strainer unit is mounted. The Inject-A-Flow pump unit is mounted on the lid of the tank with the pump operating inside the strainer unit. Pump unit consists of a precision cast, non-corrosive centrifugal pump connected to the motor through an extended shaft. Provision is made for re-circulating coolant liquid.

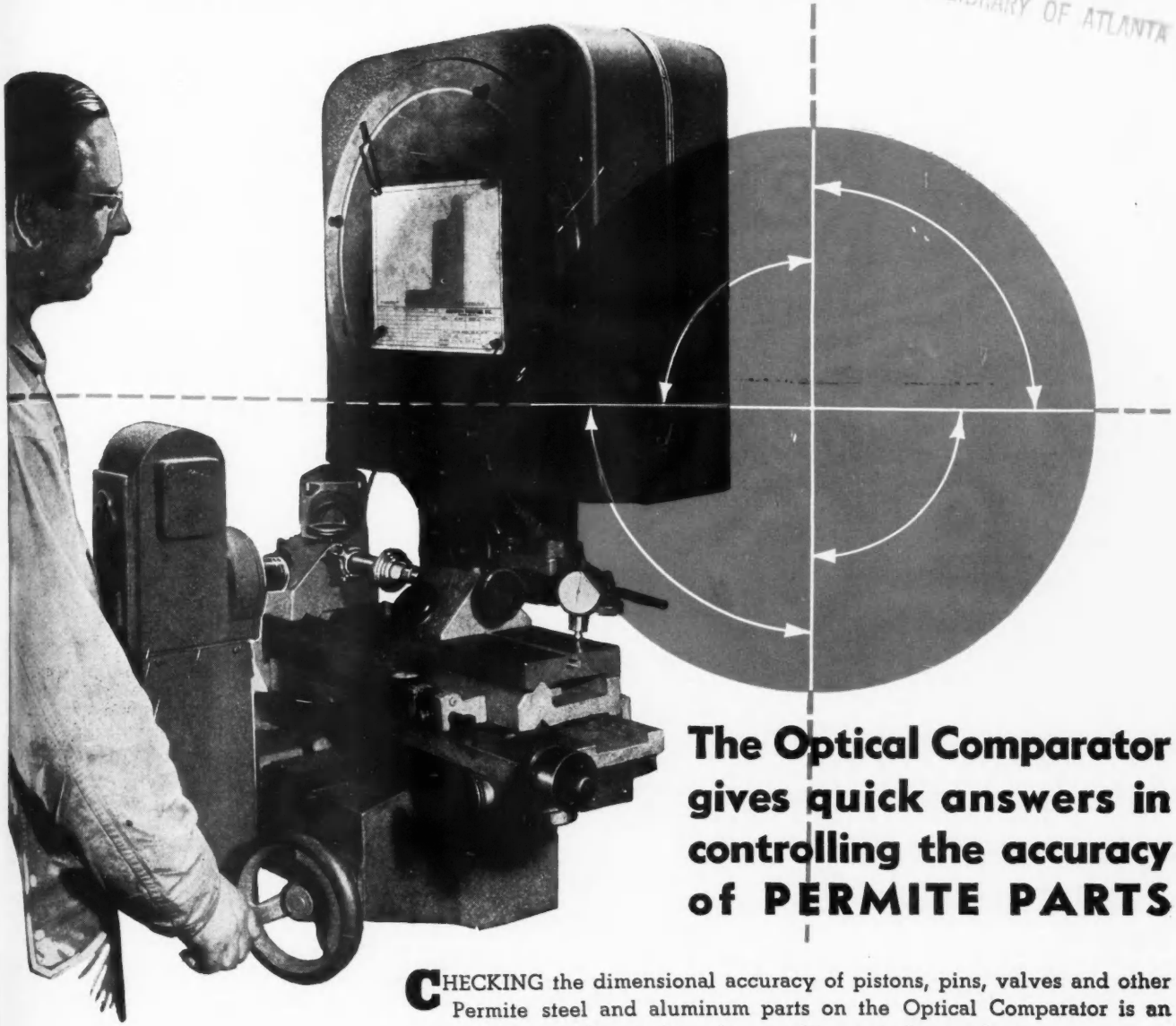
LUMA ELECTRIC EQUIPMENT CO., Toledo 1, Ohio, is manufacturing a combination Etchtool and demagnetizer which features a newly-designed tungsten marking point especially adapted to fine, deep etching on polished surfaces. This combination model has three stages of marking control—light, medium and heavy. It is not necessary to cut down writing speed to increase marking depth, as depth is automatically controlled. Each model has five ft extra flexible, light weight cable. Combined weight of cable, cork grip pencil and marking point is 10½ oz. Cable is instantly detachable from etchtool.

(*Turn to page* 88, *please*)


ATWOOD CLUTCH COMPANY
The spacious, modern plant of The Atwood Clutch Company was planned, built and equipped specifically to develop and manufacture proven clutches of advanced design for the automotive, tractor, truck, diesel and marine industries.
OVER A MILLION ATWOOD CLUTCHES IN SERVICE
*THE ATWOOD CLUTCH COMPANY, AUBURN, INDIANA, U. S. A.
* Formerly Auburn Manufacturing Company

How right is a Right Angle?

LIBRARY OF ATLANTA



The Optical Comparator gives quick answers in controlling the accuracy of PERMITE PARTS

CHECKING the dimensional accuracy of pistons, pins, valves and other Permite steel and aluminum parts on the Optical Comparator is an important step in Permite's modern quality control procedure.

The part to be checked is mounted on a universal stage and its image projected on a screen in the upper part of the instrument. Measurements are checked either by placing a properly enlarged drawing on the screen and comparing dimensions, or by moving the part so that its image traverses a distance corresponding to the dimension to be checked. A quick and accurate answer is obtained to every question involving correct dimensions, angles and radii.

This is typical of the precision practices that help insure the accuracy of Permite valves, pistons, pins, bushings, bolts, shafts and other Permite aluminum and steel parts for automotive, aircraft and general industrial applications.

Consult Permite on your parts requirements.

PERMITE

ALUMINUM INDUSTRIES, INC.

CINCINNATI 25, OHIO

DETROIT: 809 New Center Building. NEW YORK: 9 Rockefeller Plaza. CHICAGO: 64 E. Jackson Boulevard. ATLANTA: 413 Grant Building

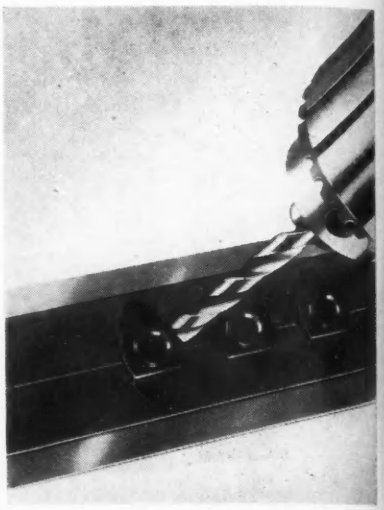
ALUMINUM PERMANENT MOLD, SAND and DIE CASTINGS...HARDENED, GROUND and FORGED STEEL PARTS

Combination Etchtool and demagnetizer

To serve every purpose, three other marking points—Elkonite, copper and carbon—are also available with this tool, and all marking points are interchangeable. All have positive screw-type connections. As a demagnetizer it is used in the tool room for demagnetizing tools that have been in contact with magnetic chuck, as it performs either operation without set-up delay.

A NEW type of drill-jig bushing has recently been introduced by the Hi-Shear Rivet Co., 1559 Sepulveda Blvd., Hermosa Beach, Calif. Called "Anchor Bushing", it consists of a formed steel anchor into which is pressed a hardened steel bushing. The bushings are supplied in standard drill sizes up to ⅜ in.

Since the Anchor Bushing can be quickly spot-welded to any flat or curved template and does not require a heavy fixture, the weight of the completed tooling is less than the weight of ordinary drill-jig fixtures.



Anchor Bushing

The low cost of the new bushings and their complete flexibility of application are said to make possible complete production tooling for a very limited number of units which would ordinarily justify only hand drilling. It is equally adaptable for precision drilling on mass reproduction jobs.

Partnership Organized for California Representation

A new firm, Chance and Blanchard, has been organized as a manufacturer's agent. With its main office in Los Angeles and an Eastern branch in New York, the organization will be set up to handle product promotion as well as complete representation in the California market. The new firm is inviting business in the automotive, aviation and industrial fields.

U. S. Rubber Co. Purchases Dispersions Process, Inc.

United States Rubber Co. has purchased the outstanding common stock of Dispersions Process, Inc. Activities of the subsidiary, which consist of the development and sale of dispersion of rubber, reclaimed rubber, plastics and other rubber-like materials, will be combined with the latex activities of Naugatuck Chemical Division.

Dispersions Process, Inc., is a Delaware corporation, organized in 1928. It controls many patents covering methods of producing aqueous dispersions.

THE NATION'S ENGINE BUILDERS

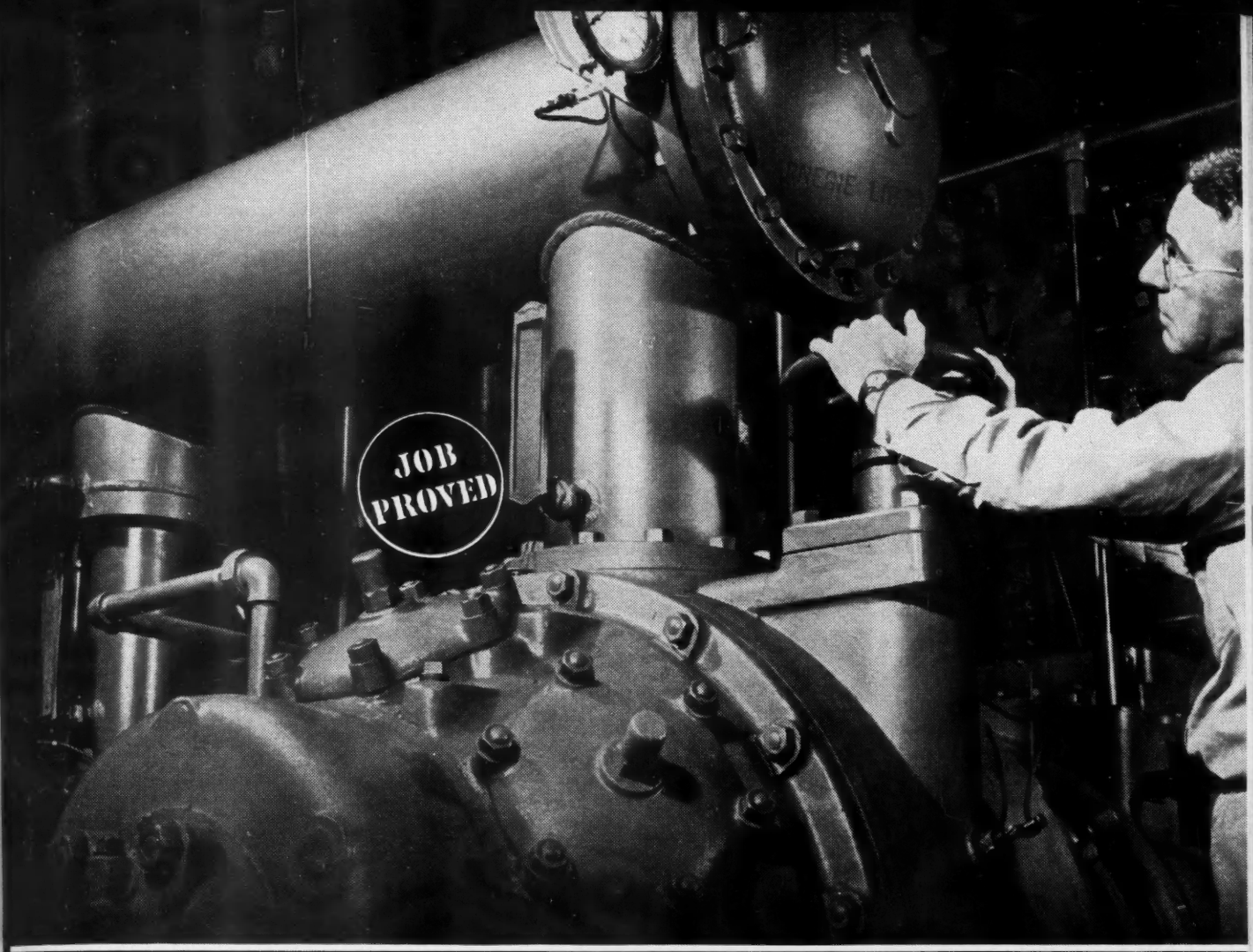
Specializing in tappets alone and equipped for large volume precision production, Johnson serves the nation's leading engine builders.

The millions of JOHNSON Tappets in use today are proving the value of doing business with a concern whose business is tappets.

Consult JOHNSON on *YOUR* tappet requirements.

Write for Folder 46A on "Self-locking Adjustable Tappets"

Johnson Products Inc.
TAPPETS ARE OUR BUSINESS
Muskegon, Michigan



2 BILLION CU. FT. OF AIR *Without Wear*

SUN COMPRESSOR LUBRICANT...

Keeps Big, Industrial, Diesel-Driven Compressors in Perfect Running Condition for Four Years

A well-known manufacturer operates a battery of big 400-H.P. Diesel-driven, 2-stage compressors, each one producing 1,850 cu. ft. of air per minute under 100 lb. pressure.

Sun oil, specially refined to meet this type of operation, was used for four years of almost continuous 24-hour-a-day operation.

During 20,000 hours of actual running, producing more than two billion cubic feet of air, there were no lubrication problems whatsoever. A routine inspection showed no apparent wear, and no replacement of parts was necessary.

For the vital equipment on your production line, in your power plant, or in your machine shop, pick the "Job-Proved" Sun lubricants that will insure low-cost, trouble-free production. Call the nearest Sun office today for information on Sun's full line of quality lubricants.

SUN OIL COMPANY • ***Philadelphia 3, Pa.***

Sponsors of the Sunoco News-Voice of the Air — Lowell Thomas

SUN

SUNOCO

INDUSTRIAL PRODUCTS

The Automobile Industry in Italy

(*Continued from page* 25)

portant Italian aeronautical and motor car works such as Alfa Romeo, Breda, Cantieri de Monfalcone, Caproni, Fiat, Isotta Fraschini, Macchi, Piaggio, Reggiane, San Giorgio, Sial Marchetti, sent a telegram to the Italian President of Ministers, in which they indicated their plan for assuring employment to about 60,000 workers, reminding them of the demand made previously in July 1945 to the qualified ministerial functionaries entrusted with the reconditioning of automotive equipment, given by the Allied Authorities to the Italian Government, declaring to be disposed to assume the gradual financing of the work.

The Allied Authorities have prohibited the exportation of automobiles and motorcycles with rubber tires. This restricted greatly the exportation of Italian automotive vehicles, although a certain number of these could be sent abroad without tires. The prices, as converted to U. S. dollars at the Milan works of Isotta Fraschini were as follows: for the D-65UMB chassis with benzene engine, complete with accessories and seven wheels without tires, about $12,200; for the D-65UMB chassis with benzene engine, open type body, without tarpaulin, with accessories and seven wheels without tires, about $13,000; the chassis of the D-80CO-II series, with Diesel engine, electric starting, with a bed in the cab, open type body, with seven wheels without tires, about $20,500.

The prices (converted to U. S. dollars) of the Bianchi Edoardo automobiles were fixed as follows: Miles chassis, six wheels without tires, with spare rim, complete with luxury cab, front mud guards and runningboard, about $12,500; Miles car, six wheels without tires, with a spare rim, without mud gards and runningboard, about $11,900; Miles car, six wheels without tires, with spare rim, complete with cab and freight platform, varnished in greenish grey, without tarpaulin, about $13,000; Miles COR, for line services and long hauls, six wheels without tires, with spare rim, without mud guards and runningboard, about $10,250; Miles bus, for line services and long hauls, six wheels without tires, with spare rim, without mud guards and runningboard, about $12,350.

Through the UNRRA the importation of rubber into Italy during the past year was elevated from 12,000 tons to 20,000 tons, at an expense of $11,000,000. Besides this, the importations of the raw materials required for the production of synthetic rubber were increased. Negotiations are proceeding between the Isotta Fraschini firm and Sweden for the exportation of automobile engines, and with England for the exportation of 1500 hp marine engines. With the view of increasing the sale on the Italian market of Diesel engines of small power, the Swedish industry is studying the possibility of purchasing an Italian dock-yard for constructing boats to be leased to Italian fishermen. In accordance with the project made in Sweden, work should be initiated with the construction of a lot of 300 fishing boats. Russia is disposed to purchase in Italy Diesel engines, Fiat and Spa trucks, electric material, ball bearings and machine tools. Payment would take place in this case through imported goods.

Although the validity of operating permits for motor cars was authorized in northern Italy on April 30, in the central and southern regions the concession system remained unchanged. On May 1, there was effected in northern Italy a contingency through which a town like Milan could obtain only 4500 permits. For the operating of automotive vehicles there had been allotted to northern Italy, in April, the following quantities of benzene: Lombardy 610 tons, Liguria 120 tons, Piedmont 330 tons and Veneto 200 tons. The direction

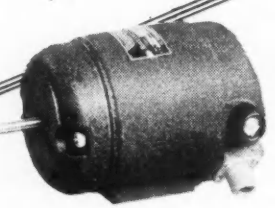
(*Turn to page* 92, *please*)

Product Performance You'll Be Proud of with *Lamb Electric* motors

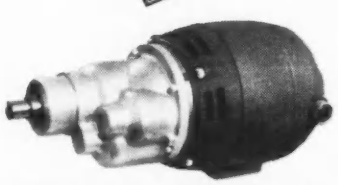
Specially designed for each particular application and with dependability built into every part, Lamb Electric Motors have established a reputation for long, trouble-free operation.

This quality of motor performance is an important factor in obtaining the high standard of product performance that is the aim of every manufacturer.

THE LAMB ELECTRIC COMPANY
KENT, OHIO

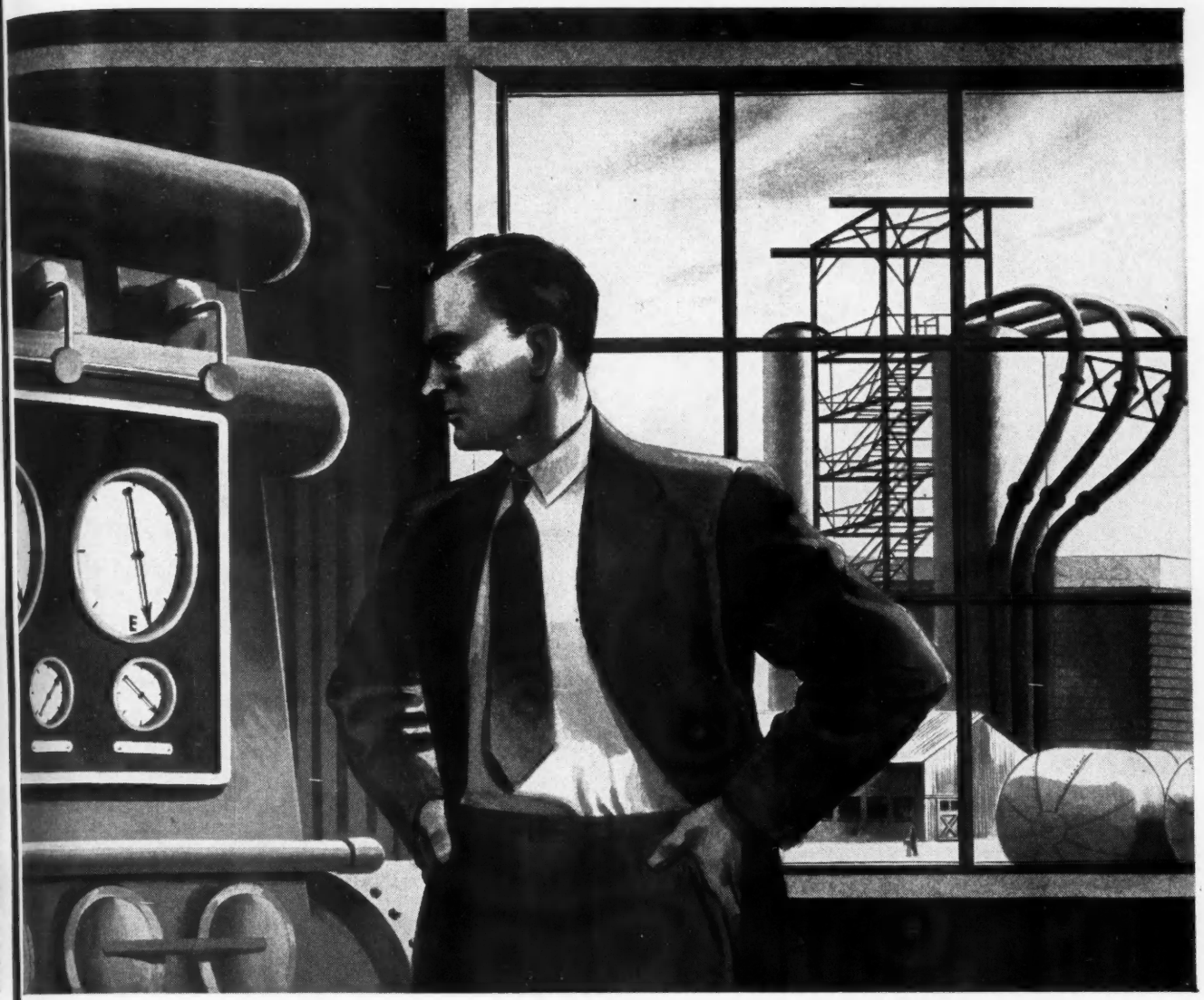


Small, sturdy motor that can be readily adapted to a wide range of industrial applications.



Light-weight universal motor with efficient spur gear speed reducer.

Lamb Electric
FORMERLY Black & Decker Electric
SPECIAL APPLICATION FRACTIONAL HORSEPOWER **MOTORS**



Even an oil company can use too much oil!

The chief engineer of a big Illinois petroleum company was pleased with the smooth, steady performance of the new Diesel he had installed. Then he checked the oil consumption and his enthusiasm ended.

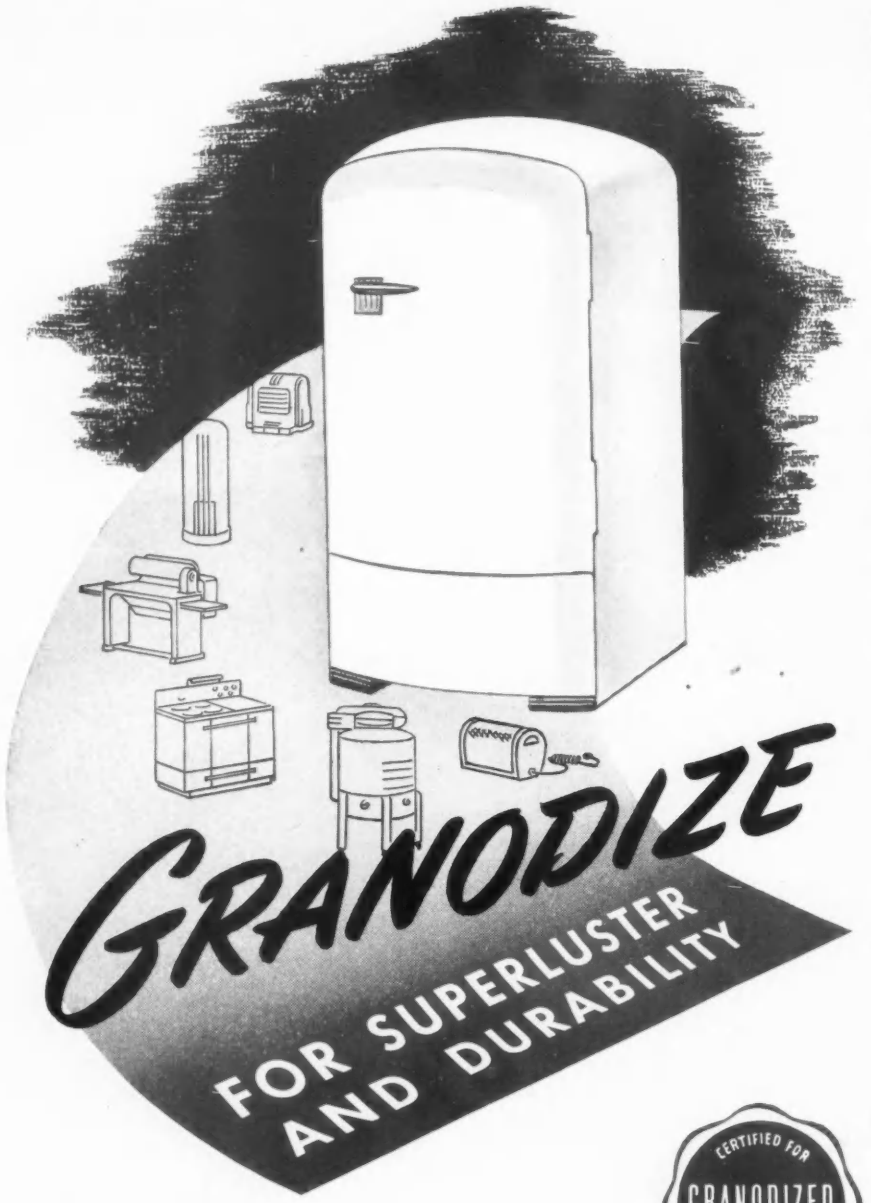
The Diesel was stopped . . . Pedrick experts called in . . . and after a quick but thorough analysis, Pedrick *precisioneered* piston rings designed to meet the special requirements of this type of engine were substituted for the original rings.

Horsepower hours per gallon of lubrication oil were immediately more than *doubled*, and after the Pedrick rings had seated themselves, were more than *tripled!*

Amazing? Not particularly. Pedrick installations in all types of internal combustion engines are cutting operating costs and increasing efficiency. Used as original equipment they help improve new engine performance. In Service Sets for reconditioning they wear-in better and stand-up longer. Let Pedrick engineers show you why. WILKENING MANUFACTURING CO., Philadelphia 42, Pa. *In Canada:* Wilkening Manufacturing Co. (Canada) Ltd., Toronto.

Pedrick

precisioneered
PISTON RINGS



Cold SPRAY-GRANODINE, makes possible that beautiful, lustrous, pure white finish so much desired on modern refrigerators, kitchen cabinets and a host of other *white finish* metal products.

Cold SPRAY-GRANODINE, the pioneer low temperature phosphate coating process (with peroxide), produces a uniform, dense, hard zinc phosphate coating that assures higher luster and paint durability needed to preserve a beautiful finish even under severe exposure conditions.

Cold SPRAY-GRANODINE, is ideally suited to processing (in continuous production in power spray washers) either large or small products, rapidly, efficiently and economically. The present trend toward Granodizing attests to its efficiency and time-proved effectiveness.

AMERICAN CHEMICAL PAINT CO.
AMBLER **ACP** **PENNA.**

of UNRRA persisted in opposing the free circulation of automobiles, and remained firm in its decision after the protests of the different automobile clubs. It was left to the Italian Government to decide on the best use to be made of the fuels which it released for distribution.

The Turin Council of the Provincial Corporation for Travel went to Switzerland and France to consult with the provincial travel authorities in those nations, having in view the increasing of interest in the construction of a tunnel under the Monginevro and Mont Blank mountains. For some time there have been amicable relations between French and Swiss tourists, relations that it is hoped will lead to the direction of many foreign tourists into Italy.

No new Bugatti racing car will be placed on the market, as the Italian and French builders have suspended for the present any further constructions of new racing cars because of the deficiency of materials.

The price established by the Interministerial Committee for the importations of trucks from the United States was varied in accordance with the load capacity and destination. For this reason the price was fixed at $6,000 for a load capacity of five tons, when the truck was given in concession to a State Corporation or destined for State automotive services, while the price was set at $8,000 and $13,000 for load capacities of three and five tons respectively, when the truck was sold for industrial or agricultural use.

American, British, French, Swiss, Swedish delegates and representatives of other six European nations assisted in the inauguration of the first Italian Congress of Technic and Economy for Air Transportation. This Congress was organized in collaboration with the College of Engineers in Milan and the Italian Association of Aerotechnic.

Du Pont Plans to Market Anti-Knock Mixtures

The Du Pont Co. has announced plans for the wide marketing, sometime in 1948, of anti-knock mixtures containing tetraethyl lead for addition to gasoline. The company has been manufacturing such mixtures for the Ethyl Corp. since 1925.

In connection with the plans for expansion of its business in the whole field of petroleum additives, Du Pont also announced the appointment of Ray E. Miller, formerly a vice president of the Warren Petroleum Corporation, Tulsa, Okla., as sales director for petroleum additives in the Organic Chemicals Department, and J. J. Mikita, formerly associate research director of The Texas Company, as an assistant to J. R. Sabina, technical director of the petroleum chemicals division.

METAL is Saved and REJECTS are Fewer

When "N.C.R.'s" Die-Caster Pots Have Micromax Pyrometers

Big die-caster pot gets automatic Micromax temperature control, in National Cash Register Co.'s Dayton, Ohio, plant. Photo shows pot partly dismantled for maintenance. Above, twelve Micromax Recorders and one Controller.

The problem of holding correct temperatures in die-caster pots is greatly simplified for National Cash Register Co. by the Micromax Pyrometers shown above. Some of the Pyrometers are Recorders, others are fully-automatic Controllers . . . the selection depending on the type of work being handled.

In either case, automatic instrumentation has proved a good investment. Regarding the Controllers, the superintendent says that "no man could hold the same even temperature, even if he stood by a caster pot and watched temperature all the time. Micromax helps save metal and fuel, by making the die casting more accurate and by reducing the number of rejects."

Perhaps you have a similar problem. For specific details on how Micromax Pyrometers can be applied, write us describing your needs. Or mention N-33A, if you prefer a Catalog.

LEEDS & NORTHRUP COMPANY, 4966 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl. Ad N-33A-646(3)

News of the Industry

(*Continued from page* 52)

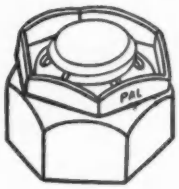
number of engineering, purchasing, and other types of salaried employees has not been tabulated on an industry-wide basis, but it is known to be substantial. Paper work required by government controls, and parts and materials shortages have added heavily to the number of expediters and clerical employees. One company is known to have 18,000 more salaried workers than before the war, another has doubled in that category, and a third has added 2000.

Kaiser and Frazer Prices Reflect Production Troubles

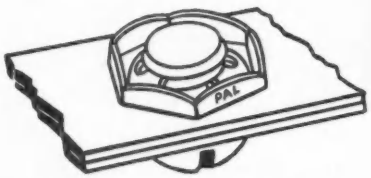
Back about a year ago, when the Kaiser-Frazer Corp. was just getting going, there was considerable talk about a price of around $1000 for the Kaiser front-wheel drive car and about $1200 for the Frazer. However, when OPA announced prices for the Kaiser Special and the Frazer recently, it was found that price tags were about 75 per cent above original expectations. List prices for the cars are $1645 for the Kaiser Special and $1795 for the Frazer. Delivered price for the four-door sedan in Detroit is set at $1850.41 and $2008.93 respectively. OPA stated that a review of anticipated normal future volume indicated that, even discounting the high costs attributable to starting expenses and low volume due to material shortages, the maximum prices would not permit break-even operations for at least six months and that only a production rate substantially in excess of those considered likely by the companies involved (K-F and Graham-Page) would yield an operating profit on a normal cost basis. OPA also said the prices are only temporary and are subject to review and modification on or before next March 31.

Why leaders in every field use PALNUTS—

ALWAYS HOLD TIGHT
•
EASY AND FAST TO ASSEMBLE
•
LOW IN COST
•
WITHSTAND HIGH TEMPERATURE
•
DO NOT DAMAGE NUT OR NUT SEAT



Used as locknut on heavier assemblies



Used alone as self-locking nut on lighter assemblies.

• Send details of your application for recommendation and free samples. Ask for literature describing Palnut double-locking principle, advantages, types, sizes, etc.

THE PALNUT COMPANY 60 CORDIER ST., IRVINGTON, N. J.

DOUBLE-LOCKING PALNUTS

Ford Announces New International Division

Creation of a new international division of Ford Motor Co. and the appointment of R. I. Roberge, manager of all Ford foreign operations, to head it as general manager, were announced by Henry Ford II, president. Mr. Ford said that all personnel of the former foreign operations division, together with the functions and responsibilities of the division, have been transferred to the international division.

Weekly Production of Cars and Trucks in U. S. and Canada

Week ending	1946	Corresponding Week in 1941
Jan. 5	13,920	76,935
12	23,340	115,935
19	28,465	124,025
26	29,410	121,948
Feb. 2	29,295	124,400
9	23,785	127,675
16	21,555	127,510
23	19,410	127,740
Mar. 2	17,575	126,550
9	23,050	125,915
16	35,020	131,410
23	37,285	123,805
30	43,070	124,165
Apr. 6	47,735	116,255
13	49,425	99,260
20	57,565	99,945
27	64,620	108,165
May 4	67,060	130,610
11	71,335	132,380
18	48,565	127,255
25	53,020	133,560
June 1	31,895	106,395
8	43,175	133,645
15	50,206	134,682
22	54,475	133,565
29	60,015	127,926
July 6	45,175	96,457
13	74,015	114,318
20	80,395	109,912
27	84,720	105,635
Aug. 3	79,385	62,146
10	77,825	41,795
17	88,990	45,550
24	91,360	45,525
31	74,960	39,965
Sept. 7	72,535	32,940
14	88,888	53,165
21	80,972	60,615
28	86,582	77,035
Oct. 5	90,165	76,820
Total	2,160,238	4,123,534

YOU GET MORE PRODUCTS PER TON WITH N-A-X HIGH-TENSILE STEEL

★

The High Physical Properties of This Low-Alloy Steel Can Make Your Sheet Steel Go 33% Farther

★

Smaller Sections Provide the Saving

N-A-X HIGH-TENSILE steel has the strength, toughness, fatigue- and corrosion-resistance to permit reductions up to 25% in sectional thickness when it replaces carbon sheet steels. These outstanding properties mean durability in your finished part or product. And they are translated into production increases up to 33%.

Good Formability Makes the Switch Feasible

N-A-X HIGH-TENSILE is exceptional among high-strength steels because of its unique combination of strength *and ductility*. It can be cold-formed to intricate shapes and deep-drawn to produce parts normally fabricated out of mild carbon steels. N-A-X HIGH-TENSILE has demonstrated its formability in scores of severe fabricating operations, and requires little or no change in die design or press capacity.

Three Tons Can Do the Work of Four

By designing sections to take advantage of the high physical properties of N-A-X HIGH-TENSILE, manufacturers can use less steel per unit, get more units per ton. How great this increase will be depends, of course, on the particular part or product. But it is entirely reasonable to expect that three tons of N-A-X HIGH-TENSILE can be made to produce as many units as four tons of carbon sheet steel.

NOW LET'S LOOK AT OVER-ALL COSTS

There is only one fair way to compare the price factor of N-A-X HIGH-TENSILE and carbon sheet steel, and that is on the basis of over-all costs. It is our conviction that N-A-X HIGH-TENSILE will "pay its own way" by increasing production per ton, and by making possible many economies in handling, fabricating and finishing. We are ready to work with you closely on your particular problem of using N-A-X HIGH-TENSILE to make a ton of steel go farther.

MAKE A TON OF SHEET STEEL GO FARTHER
Specify—
N-A-X
HIGH-TENSILE STEEL

GREAT LAKES STEEL
Corporation
N-A-X ALLOY DIVISION • DETROIT 18, MICHIGAN
UNIT OF NATIONAL STEEL CORPORATION

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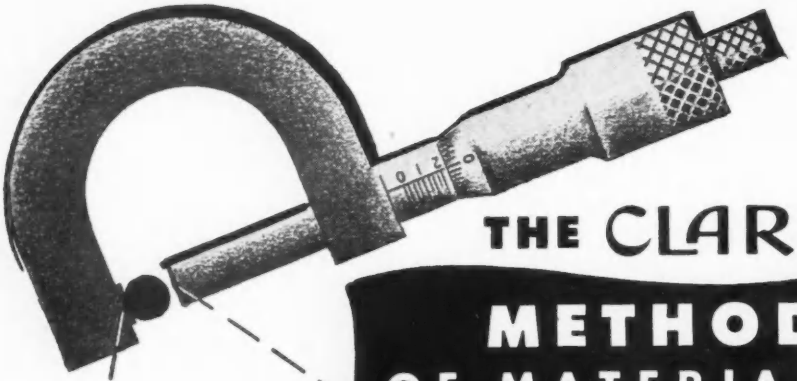


THE CLARK

METHOD OF MATERIAL HANDLING INVITES INSPECTION

Plan to visit our exhibit, National Material Handling Exposition, Cleveland, January 14 to 17, 1947.

WRITE TODAY FOR "MATERIAL HANDLING NEWS."

LIFTS – CARRIES – TIERS
GAS OR ELECTRIC POWERED

CLARK TRUCTRACTOR
Division of CLARK EQUIPMENT COMPANY
BATTLE CREEK, MICHIGAN
OTHER PLANTS – BUCHANAN, JACKSON, BERRIEN SPRINGS, MICHIGAN

Other CLARK *Products*

FORK LIFT TRUCKS
DUMP & SHOVEL TRACTORS
RAILWAY TRUCKS
METAL SPOKE WHEELS
TRANSMISSIONS
AXLES AND HOUSINGS
DRILLS & GEARS
ELECTRIC STEEL CASTINGS

Prices on CLARK products will not be advanced in excess of increased costs.

New Products

(*Continued from page* 50)

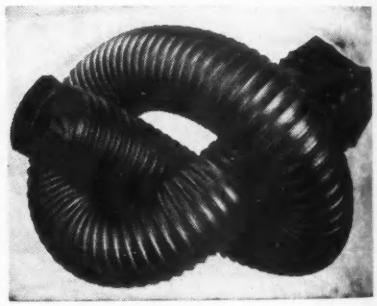
rection, the ring forms a complete annular shoulder of uniform section height around the circumference of the shaft, thereby eliminating the wide gap characteristic typical of conventional open type "C" rings. This feature is said to increase substantially the normal thrust capacity of the ring.

Consisting of two mating halves that interlock, the ring is of dynamically balanced design and therefore particularly suitable for equipment involving high rates of rotation. Because of its positive interlocking action, the ring cannot be lifted out of its groove by high centrifugal forces or by linear expansion caused by friction with abutting parts or surfaces. Yet, disassembly of the ring requires nothing more than a slight prying action with a screw driver.

Hose Made by New Process

A new process for the manufacture of lightweight spiral-wire reinforced hoses and accessories has been originated by the American Ventilating Hose Co., 15 Park Row, New York 7, N. Y. It has been designated as the "Continuous Wind" process to differentiate between it and other manufacturing methods.

Using neoprene pre-coated fabrics, the new process provides for the manufacture of continuous hose lengths in any required diameter from 1 in. to



Continuous Wind Process Hose

24 in. It simplifies any construction changes that may be necessary to secure various degrees of flexibility, compressibility, crushing resistance and other physical characteristics.

Cuffs, bushes, reducers or flanges can be permanently attached to any of these hose lengths if required, thus simplifying the connections on many types of industrial equipment, particularly those having outlets of different size or shape.

Low-Melting, High-Strength Silver Welding Alloy

Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y., offers a new welding alloy for making high-strength welds on ferrous and non-

(*Turn to page* 98, *please*)

PERMANENT RESILIENCE

Resilient parts made from HYCAR synthetic rubber *stay* resilient. That's partly because of HYCAR's unusual chemical stability—its resistance to oil and gas, acids and most other chemicals. And parts made from HYCAR are extremely resistant to the effects of oxidation, sunlight, and normal aging. A HYCAR sealing ring, for example, will maintain a positive seal through years of service even when constantly exposed to oils and acids inside the pipe, and sunlight and salt air outside.

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That's why we say ask your supplier for parts made from HYCAR. Test them in your own applications, difficult or routine. You'll learn for yourself that it's wise to use HYCAR for long-time, dependable performance. For more information, please write Dept. 1H-10, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio.

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6. *LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.*
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9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

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ferrous metals at an exceedingly low melting point. Known as EutecRod 1801, it is applied by the oxyacetylene torch, furnace, or high frequency induction heating equipment. It bonds at base metal temperatures of 940-1120 F, and melts at 1143 F. At this temperature, it will flow freely into close-fitting joints due to its high capillary action. In addition, weld deposits are said to have a shear strength of 120,000 psi, good corrosion resistance and good electrical conductivity.

This welding rod is available in rod, wire, strip and powder form. It is used with a special flux, Eutector flux 1801.

Flexible Polishing Wheel

The Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, N. J., has added a new, flexible polishing wheel to its line of polishing and finishing wheels. This innovation is the most flexible of this series of soft neoprene bonded polishing wheels. The extreme flexibility and "cushion" action of this wheel is due to the fact that the wheel is bonded with a specially modified compound of neoprene impregnated with abrasive grain. Working with a closely-controlled method of manufacture, this neoprene wheel can be varied over a wide range of densities depending on its ultimate application. A combination of porosity and a soft bond is said to result in a wheel which gives superior finishes. Due to the nature of this softest bond its speed limited to 3000 sfpm. This Manhattan wheel is supplied in the finer abrasive grain sizes or with pumice, rottenstone or other mild abrasives and is very effective in blocks and rubbing pads as well as in wheel form.

Inner Tube of Waffle-Like Construction

An automobile inner tube of waffle-like construction, designed to prevent rapid deflation in the event of a puncture, is announced by the United States Rubber Co., New York, N. Y.

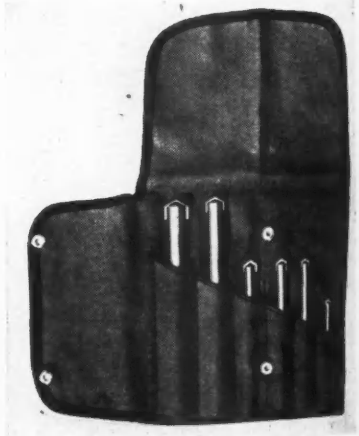
The crown of the new tube is composed of a patchwork of square pockets which press against the inside of the tire as the tube is inflated. If the tube is punctured by a nail, this squeezing action crowds the rubber around the nail. Thus the tube loses air at a much slower rate, allowing the driver to proceed a greater distance before stopping for repairs.

Improved Line of Carboloy Masonry Drills

The improved line of Carboloy masonry drills made by Carboloy Co., 11151 E. Eight Mile Drive, Detroit 32, Mich., now includes 15 sizes, ranging from 3/16-in. nominal diameter to 1½-in. nominal diameter. Sufficient over-size allowances are provided for proper hole size required for installation of such devices as expansion shields, anchors and toggle bolts.

The improved drill design features a solid round shank without flutes which gives greater strength and maximum possible support to the Carboloy cemented carbide cutting tip. According to the manufacturer, the new round shank gets dust out of the drilled holes better than the former fluted design.

The drills come individually packaged. The six most commonly used sizes are available in a canvas kit, the set comprising 3/16-in., ¼-in., 5/16-in., ⅜-in., ½-in. and ⅝-in. nominal diameter drills.



Carboloy masonry drill kit

When production, engineering and purchasing men discuss brake lining, it's only natural that Grizzly is brought into the conversation. Grizzly's position as one of the largest, most dependable brake lining manufacturers plus its enviable record of producing fine brake lining for both automotive and industrial fields for over 30 years, merit the projection of Grizzly into any brake lining discussion.

The next time brake lining or brake lining problems enter your job, consult Grizzly. Grizzly's research, engineering and manufacturing experiences can be of real assistance to you.

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The Highway Transportation Congress

(*Continued from page 27*)

forts must be applied to bring about increased highway safety. Increases in the number of motor vehicles and in traffic volume during the next decade should produce sufficient state highway user revenues at current tax rates to finance the highway users share of the highway program.

Upon us depends, in considerable measure, the responsibility for getting behind all activities that will promote greater safety on the highways. It is our duty to support laws and regulations under which highway transportation will develop in the public interest. The manufacturers are acutely conscious of their responsibility to make motor vehicles as inherently safe as possible. The engineering report which came out of the President's safety conference clearly states that emphasis on safety in design has produced vehicles which can be operated safely without unreasonable effort by drivers who exercise normal care.

Despite progress that has been made in the past there is still room for improvement along these lines. No stone will be left unturned in our continuous efforts to make the motor vehicle as safe as is humanly possible.

Federal excise taxes levied against highway users are super-imposed on various state taxes, such as license fees and gasoline taxes, which the motor vehicle owner pays for the right to use the highways. But the Federal taxes are not paid for the right to use the highways; they are merely a matter of raising general funds. Their effect is that the motor vehicle owner is singled out to bear a disproportionate share of the general tax burden.

Federal excise taxes were introduced as emergency measures in 1932, and were increased during the war and since the emergency and the war are over, now is the time for the repeal of these taxes.

The most lucrative of the Federal excise taxes has been the one and one-half cent levy on each gallon of gasoline, which has produced almost four billion dollars since 1932, and the tax applied to wholesale prices of new automobiles and trucks, which has yielded more than a billion and a half dollars over the years since 1918.

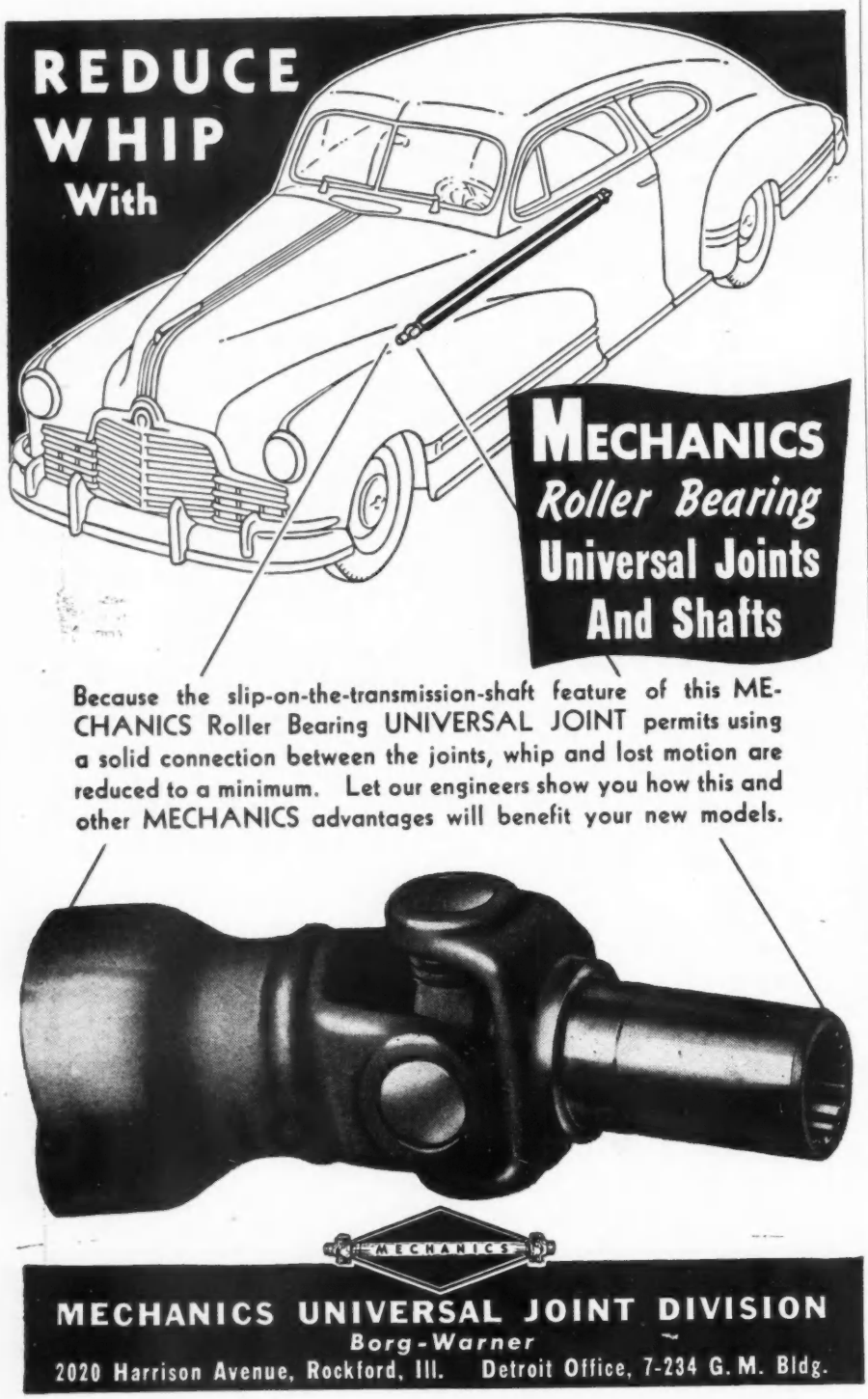
The report of the late Joseph B. Eastman, Federal Coordinator of Transportation and one time chairman of the Interstate Commerce Commission—a report based on an exhaustive study of all forms of transportation—demonstrated conclusively not only that highway users were paying their way but that they had actually made very substantial overpayments during the decade preceding the study.

The Eastman report estimated that total motor vehicle user payments to the states and local governments during the period 1921 through 1937 were $10,884,706,000 and that the total costs of highways assignable to motor vehicle users were $10,358,568,000, or a total overpayment of $526,138,000, excluding so-called "legal" diversions and other adjustments. The adjusted total excess was $386,360,000. This subsidy study was based solely on the revenues collected by the states, and did not take into consideration Federal excise taxes paid by highway users, running into millions of dollars annually.

By 1960 the states in the aggregate will be collecting approximately one and three-quarter billion dollars annually from the highway users. It would certainly seem that this huge amount of state highway revenues, will be adequate, generally speaking, to take care of the highway users share of all highway needs if the money is wisely and properly spent.

Attempts may be made to increase automotive tax rates in many of the 44 states whose legislatures will convene in 1947. Pertinent questions should therefore be asked to determine whether or not the motor vehicle tax

(*Turn to page 102, please*)



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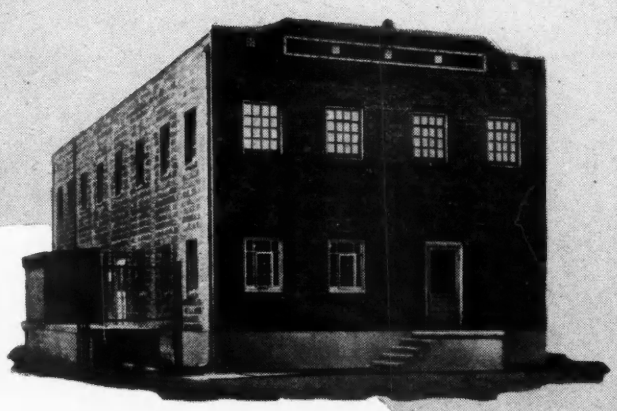

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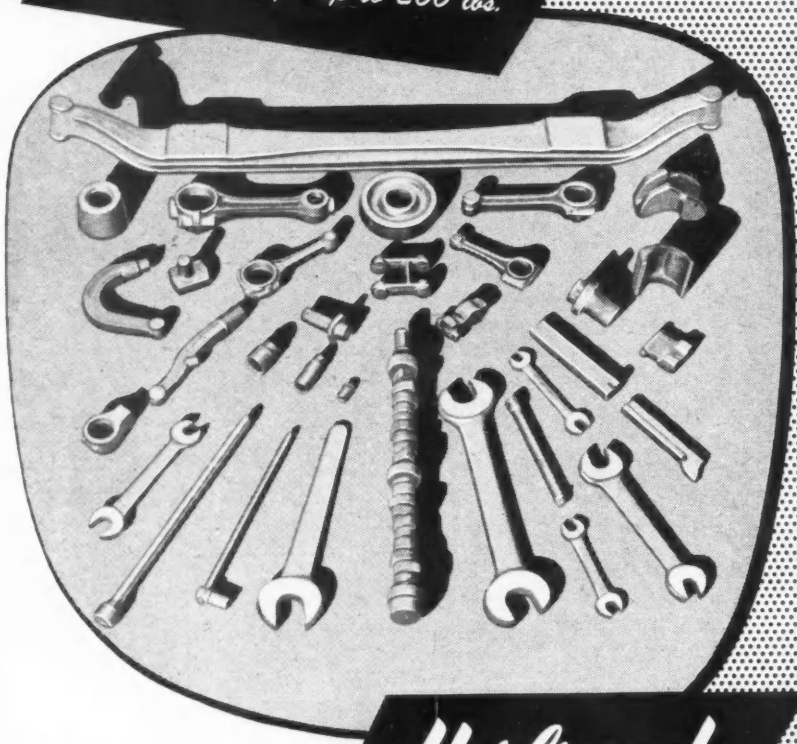

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revenues are being used for purposes other than highways or whether the monies are being dispensed or dissipated in other ways.

While eighteen states have now adopted amendments to their constitutions prohibiting use of highway funds for other than highway purposes many other states are guilty of the practice of diversion of the funds which results in a discriminatory tax that digs deeply into the pocketbooks of hundreds of thousands of low-income Americans who must use motor vehicles in the pursuit of a livelihood.

Three factors should be kept uppermost in consideration of post-war highway construction projects: First, the need; second, the planning of sound programs; third, the ability of the taxpayer to foot the bill.

Highway Barriers

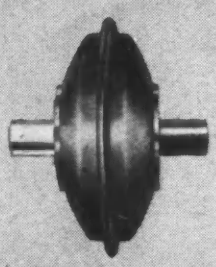
By William L. Chenery,
Publisher, Collier's Weekly

HIGHWAY barriers are a threat to the American standard of living. Discrimination against interstate trucking, where it exists, is a part of a very large effort to separate the states into 48 different economies. If this could actually be achieved it would be disastrous to the states as well as the nation. Most of the laws and regulations (of a "barrier" nature) were established at the request of citizens who felt unwilling or unable to meet the competition of their fellow citizens of other states.

The United States has been historically the largest free market in the world, and this market was developed because the Constitution prohibited tariff barriers between the states. The absence of trade barriers between the states unquestionably marks one of the important differences between the United States and the northern portions of Western Europe.

If Germany, France, Scandinavia and the Low Countries and the old Austria-Hungary had been a compact single market as was the United States during the 19th and 20th centuries, the standard of living of Euro-

(*Turn to page* 104, *please*)



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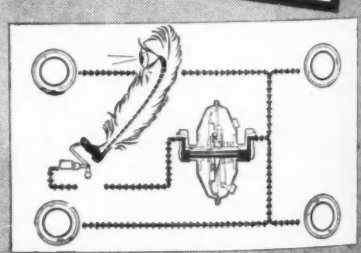

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peans might very well have been higher than the standard of living reached in the United States, and incidentally they and we need not have fought two world wars.

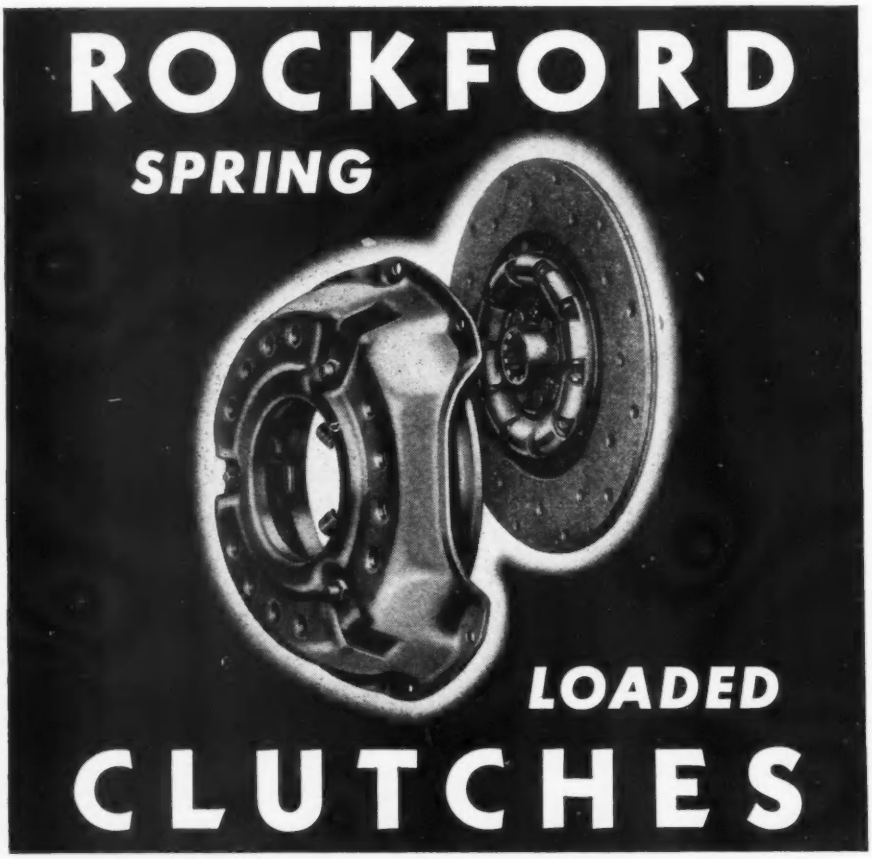
We began to squander our great national asset of a free continental market in an understandable and tragic fashion. The states could not directly get any tax benefit from levying import duties on the products of other states but different groups of citizens asked for special consideration because of their peculiar difficulties. The Council of State Governments at its Chicago meeting in 1939 listed ten different ways in which interstate trade barriers had been created during the preceding years.

We are especially concerned with motor vehicle and truck regulations, ports of entry and discriminatory taxes levied upon itinerant truckers, but these by no means exhaust the list of devices to erect interstate trade barriers. Laws taxing and otherwise discouraging the use of oleomargarine antedated the truck and motor vehicle legislation.

There is very little objection to a law designed honestly to protect public health against dirty milk or to protect the citrus industry against the invasion of disease. There is every reason, however, to protest against actually discriminatory laws that seek to conceal their real purpose by fraudulent use of the police power or of some other valid sanction.

Obviously the American standard of living could not endure if the great American market were divided into 48 component parts. If, to be specific, the automotive industry had to operate in the United States as the automotive industries of Belgium, the Netherlands, Norway, Sweden and other small sovereign states do operate, motor cars would be as scarce and as restricted in their use in the United States as they now are in Europe.

The war brought about voluntary cooperation between the states to eliminate highway barriers between the states so far as trucks and highways are concerned. These gains can be retained through interstate cooperation commissions and an informed public to defend the freedom we enjoy.



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America's Policy on Rubber

By John L. Collyer,
Pres., B. F. Goodrich Co.

AMERICAN produced synthetic rubber can be the means to effect a reduction in the higher arbitrary price of crude natural rubber which the United States is paying at Far Eastern ports. It can be marketed profitably at from 15 to 17 cents per pound, compared with the arbitrary price of 23½ cents which this nation is paying for crude rubber in the Far East.

Agreements between the United States and the United Kingdom, the Netherlands and France, call for this nation to buy 145,000 tons of crude rubber in the second half of 1946 at 23½ cents per pound. The price to the United States was increased from 20¼ cents per pound when former price contracts ended June 30.

Assuming the 2¼ cent differential between the government's buying price and its selling price is maintained this would mean a delivered price to industry of 25¾ cents a pound for crude rubber.

Striking progress has been made in reducing the production cost of general purpose American-made rubber. After V-J Day it was possible to eliminate some of the high cost production, and this and more efficient operation have reduced the average cost of the main type American-made rubber to less than its selling price of 18½ cents established by the government. The United States can now produce about 600,000 tons a year of the main type rubber at a plant cost of 12 cents a pound, or less. Even counting in plant amortization, depreciation, distribution expense and return on capital invested, American industry could produce up to 600,000 pounds of this rubber for be-

(*Turn to page* 106, *please*)

Imagine Solar having Paul Revere's strange problem!

PAUL REVERE'S fame got in the way of his reputation. Everybody knows about his horseback ride, but few remember him as America's foremost silversmith... the leader in his field.

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tween 15 and 17 cents a pound.

Until the supply position is such that crude rubber and American-made rubber can meet in outright competition, it is impossible to get a true picture as to how preference for crude rubber will stand up with that indicated differential of 8 cents or more a pound in favor of the American-made product.

Unquestionably the selling price of crude would come down to meet competition if necessary. Before the war crude rubber could be laid down in New York by reasonably efficient producers, and with a fair profit, at 10 cents a pound. The hope for crude rubber lies in its continuing ability to remain competitive with a new and vigorous American synthetic rubber industry.

The peoples of the world should be the ultimate beneficiaries of the war-born large scale competition between crude and American rubber. This benefit may be anticipated in the form of low cost finished products and the wider use of rubber in many applications made possible by its low cost.

The first step to accomplish these benefits is that serious consideration be given to returning crude rubber to a free-market basis so far as purchases by the United States or its industries are concerned at the expiration of the present buying agreements on Dec. 31, 1946.

The United States government should proceed with the program recommended by the Government's Inter-Agency Policy Committee on Rubber of selling or leasing to private industry rubber producing facilities, with provision for safeguards necessary to insure minimum capacity and production vital to our nation's military security.

Potential world production capacity is 1,400,000 tons each for crude and synthetic rubber. Of the synthetic production, 1,200,000 tons is in the United States. This grand total capacity of 2,800,000 tons is nearly two and a half times the 1940 world consumption of 1,200,000 tons.

Production of tires in 1946 should be about 85,000,000 units, more than 40 per cent above the 1940 level, and 1947 production should be nearly as great as this year's. If production continues at the present high level, the supply will be sufficient to satisfy the pent-up demand during the early part of next year. I use the word "if" because of possible shortage of component materials and because of the possibility of another epidemic of strikes.

Barney Oldfield

Berna Eli (Barney) Oldfield, 68, best-known of all pioneer American automobile racers, died Oct. 4 at his home in Beverly Hills, Calif.

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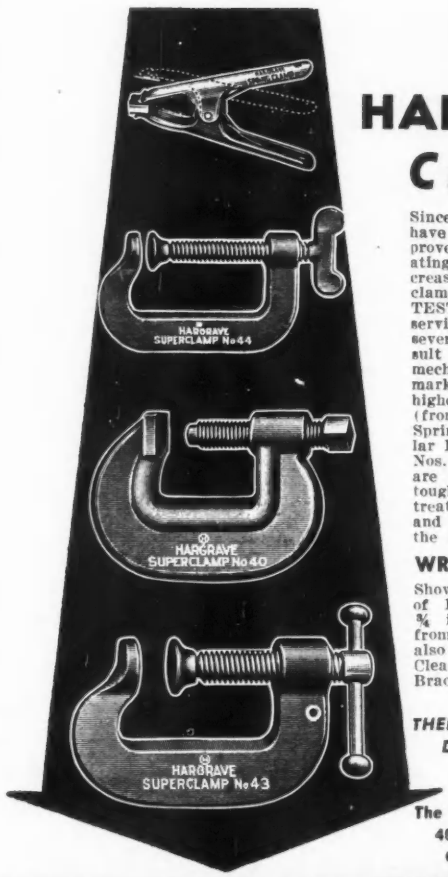

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